CIVE281 ANLYTICAL MECHANICS

Assignment No.4 (due Friday October 6)

1. B&J 7th SI Question 13.83

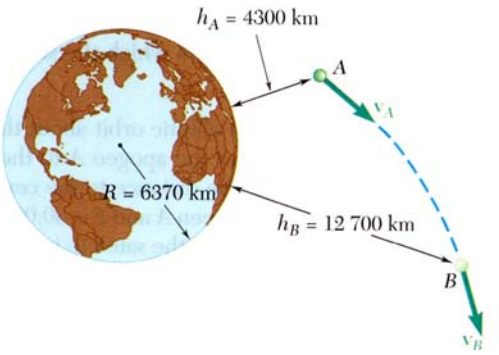
2. B&J 7th SI Question 13.95

3. B&J 7th SI Question 13.97

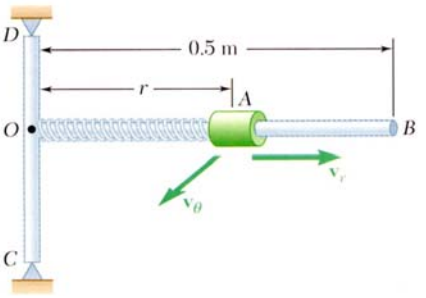
4. B&J 7th SI Question 13.105

5. B&J 7th SI Question 13.113

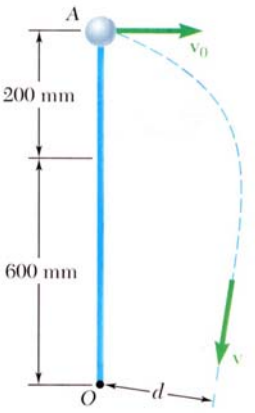
13.83 Knowing that the velocity of an experimental space probe fired from the earth has a magnitude $v_A = 32.5$ Mm/h at point A, determine the velocity of the probe as it passes through point B.



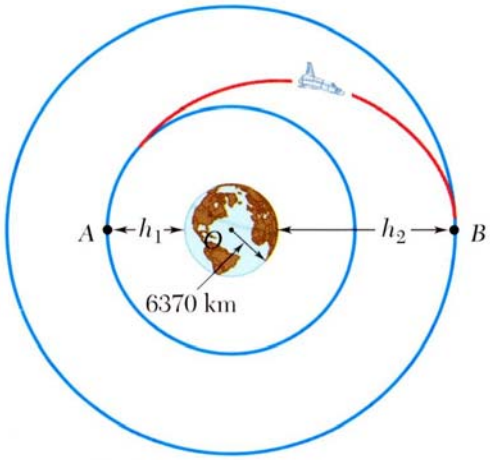
13.95 A 2.5 kg collar A is attached to a spring of constant 750 N/m and undeformed length 150 mm. The spring is attached to point O of the frame $DCOB$. The system is set in motion with $r = 250$ mm, $v_\theta = 0.5$ m/s, and $v_r = 0$. Neglecting the mass of the rod and the effect of friction, determine the radial and transverse components of the velocity of the collar when $r = 120$ mm.



13.97 A 0.7-kg ball that can slide on a *horizontal* frictionless surface is attached to a fixed point O by means of an elastic cord of constant $k = 150$ N/m and undeformed length 600 mm. The ball is placed at point A, 800 mm from O, and given an initial velocity $\mathbf{v}_0$ perpendicular to OA. Determine (a) the smallest allowable value of the initial speed v_0 if the cord is not to become slack, (b) the closest distance d that the ball will come to point O if it is given half the initial speed found in part a.



13.105 The optimal way of transferring a space vehicle from an inner circular orbit to an outer coplanar orbit is to fire its engines as it passes through A to increase its speed and place it in an elliptic transfer orbit. Another increase in speed as it passes through B will place it in the desired circular orbit. For a vehicle in a circular orbit about the earth at an altitude $h_1 = 320$ km, which is to be transferred to a circular orbit at an altitude $h_2 = 800$ km, determine (*a*) the required increase in speed at A and B, (*b*) the total energy per unit mass required to execute the transfer.



13.113 A satellite is projected into space with a velocity $\mathbf{v}_0$ at a distance r_0 from the center of the earth by the last stage of its launching rocket. The velocity $\mathbf{v}_0$ was designed to send the satellite into a circular orbit of radius r_0. However, owing to a malfunction of control, the satellite is not projected horizontally but at an angle α with the horizontal and, as a result, is propelled into an elliptic orbit. Determine the maximum and minimum values of the distance from the center of the earth to the satellite.