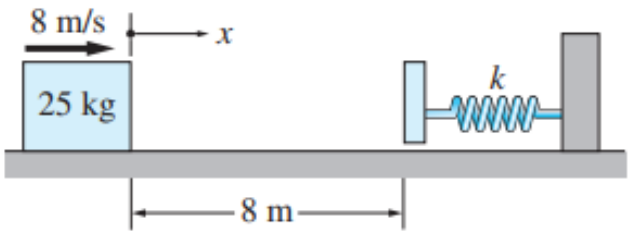
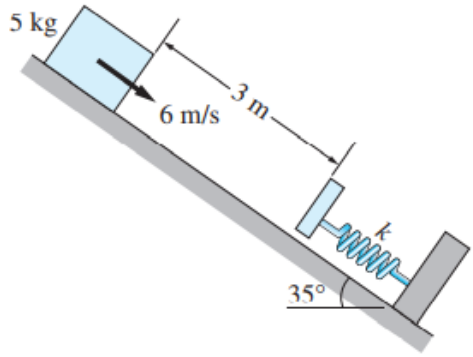
Module 5 part 2 Kinetics II (Work-Energy principle)

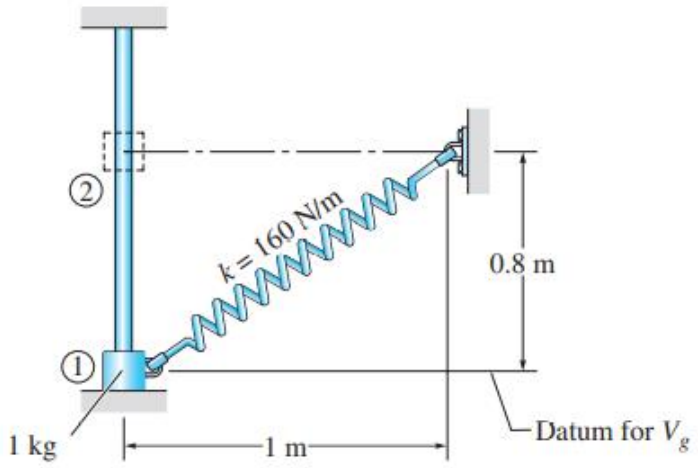
1. The 25-kg box is launched from the position shown along the rough horizontal plane with the velocity of 8 m/s. Determine the distance x that the box will travel before the spring stops the forward motion. The coefficient of kinetic friction between the box and the plane is $\mu_k = 0.2$, and the spring constant is k = 150 N/m.



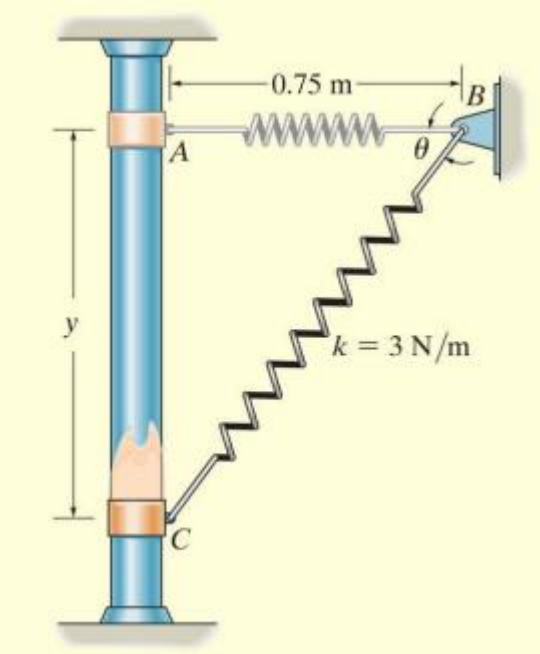
2. When in the position shown, the 5-kg box is moving down the inclined plane at a speed of 6 m/s. What is the maximum force in the spring after the box hits it? The coefficient of kinetic friction between the box and the plane is $\mu_k = 0.25$, and the spring constant is k = 4 kN/m.



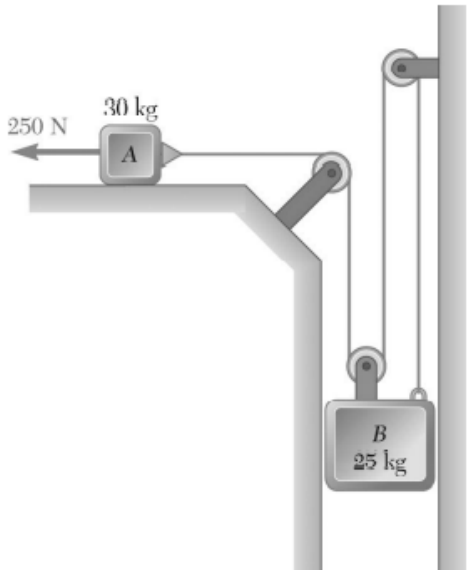
3. The figure shows a 1-kg collar that slides along the frictionless vertical rod under the actions of gravity and an ideal spring. The spring has a stiffness of 160 N/m, and its free length is 0.9 m. The collar is released from rest in position 2.



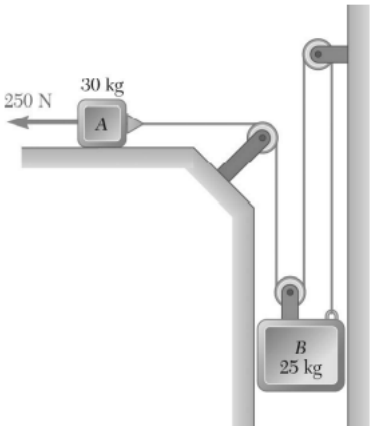
4. A smooth 2-kg collar C, shown in Fig. 13-9a, is attached to a spring having a stiffness k = 3 N/m and an free length of 0.75 m. If the collar is released from rest at A, determine its acceleration and the normal force of the rod on the collar at the instant y = 1 m.



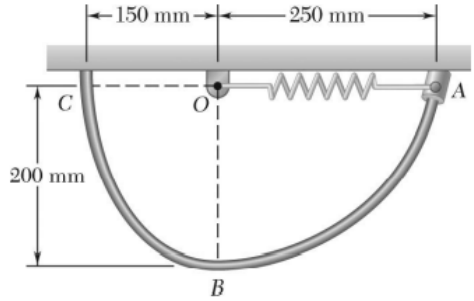
5. The system shown is at rest when a constant 250-N force is applied to block A. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between block A and the horizontal surface, determine (a) the velocity of block B after block A has moved 2 m, (b) the tension in the cable.



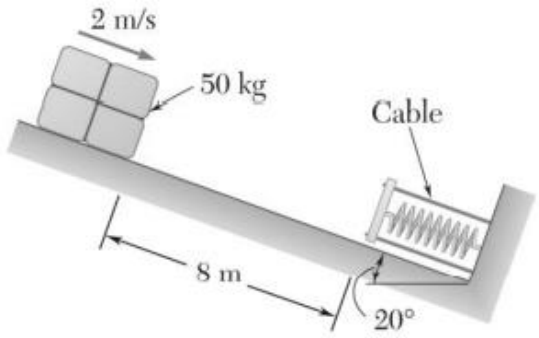
6. The system shown is at rest when a constant 250-N force is applied to block A. Neglecting the masses of the pulleys and the effect of friction in the pulleys and assuming that the coefficients of friction between block A and the horizontal surface are 0.25 μ s = and 0.20, μk = determine (a) the velocity of block B after block A has moved 2 m, (b) the tension in the cable.



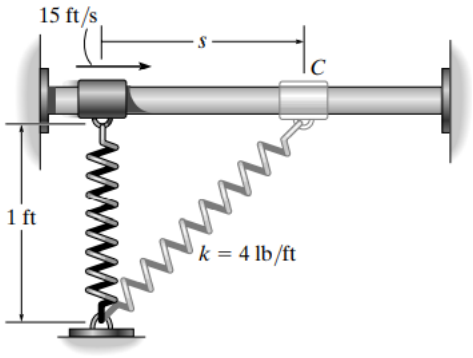
7. A 2-kg collar is attached to a spring and slides without friction in a vertical plane along the curved rod ABC. The spring is undeformed when the collar is at C and its constant is 600 N/m. If the collar is released at A with no initial velocity, determine its velocity (a) as it passes through B, (b) as it reaches C.



8. A spring is used to stop a 50-kg package which is moving down a 20º incline. The spring has a constant k = 30 kN/m and is held by cables so that it is initially compressed 50 mm. Knowing that the velocity of the package is 2 m/s when it is 8 m from the spring and neglecting friction, determine the maximum additional deformation of the spring in bringing the package to rest.



9. The 2 kg collar C fits loosely on the smooth shaft. If the spring is unstretched when s=0 and the collar is given a velocity of 15 m/s, determine the velocity of the collar when s= 1m.



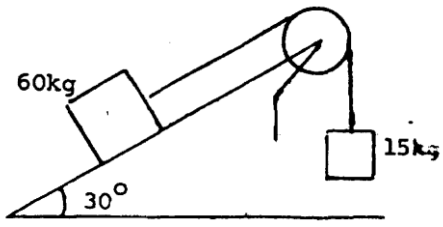
10.(a) Find the distance **d** in which a car moving at 90 KMPH can come to rest after the power is switched off if μ between tyres & road is 0.8.

(b) Also find the max allowable speed of a car, if it is to stop in the distance as above on an icy road where μ = 0.08.

(Ans : d = 39.82 m (b) V = 7.91 m/s)

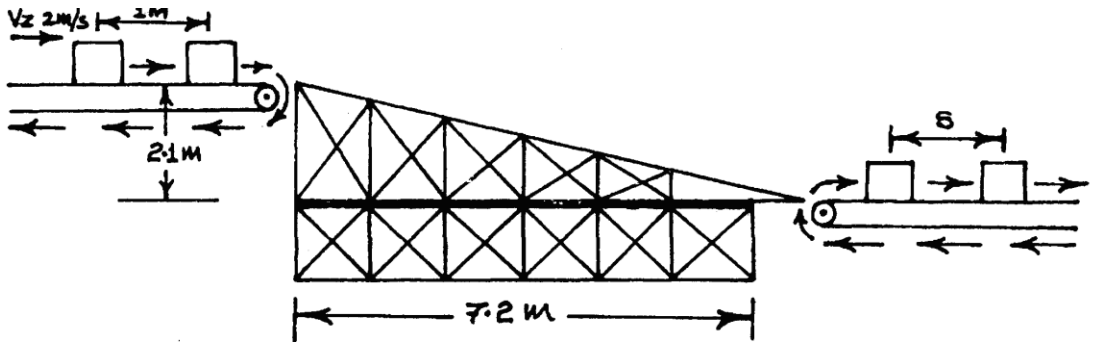
11.. Find the velocity of blocks after moving 20 m from rest. μ = 0.2.

(Ans : 4.91 m/s)



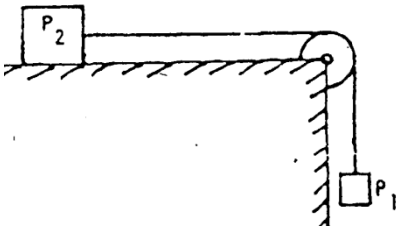
12. Packages having a mass of 5 Kg are transferred horizontally from one conveyor to the next using a ramp for which μ = 0.15. The top conveyor is moving at 2 m/s & packages are spaced 1m. Find the required speed of bottom conveyor so that no slipping occurs when packages come horizontally in contact with it. What is the spacing S between the packages on the bottom conveyor?

(Ans : 4.9 m/s, S = 2.45 m)



13. Block P_1 of weight 4N is connected to block P_2 of weight 8N by an inextensible string. Find the velocity of block P_1 if it falls by 0.6 m starting from rest. Coefficient of friction is 0.2.

(Ans : 1.53 m/s)

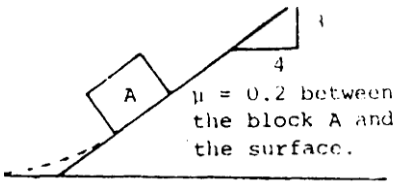


14. A bullet enters a 50 mm plank with a speed of 600 m/s & leaves with a speed of 240 m/s. find the greatest thickness of plank that could br penetrated by the bullet.

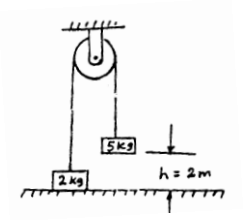
(Ans : 59.5 mm)

15. A block of mass 2 Kg & has a velocity of 5 m/s up the plane. Locate the rest position of block.

(Ans : 1.677 m)

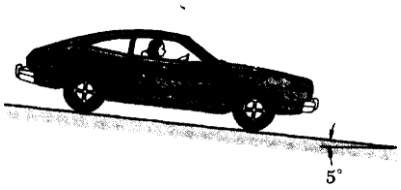


16. Two masses of 5 kg and 2 kg are positioned over frictionless and massless pulley a shown in Figure. If the 5 kg mass is released from rest determine the speed at which the 5 kg mass will hit the ground. (Ans : 4.1 m/s)



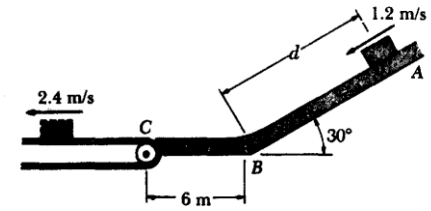
17. A 2000 kg automobile is driven down a 50 incline at a speed of 90 km/h when the brakes are applied, causing a constant total braking force (applied by the road on the tires) of 7.5 KN. Determine the distance traveled by the automobile as it comes to a stop.

(Ans : 107.95 m)



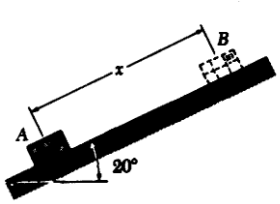
18. Packages are thrown down an incline at A with a velocity of 1.2 m/s. The packages slide along the surface ABC to a conveyor belt which moves with a velocity of 2.4 mIs. Knowing that μ_k = 0.25 between the packages and the surface ABC, determine the distance **d** if the packages are to arrive at C with a velocity, of 2.4 m/s.

(Ans : V_B = 5.93 m/s, d = 6.06 m)



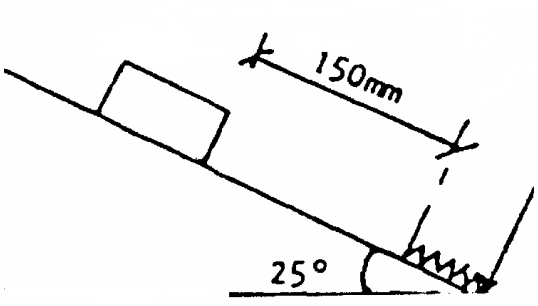
19. A 20-kg package is projected up a 20° incline with an initial velocity of 12 m/s. Knowing that the coefficient of kinetic friction between the package and the incline is 0.15, determine (a) the maximum distance x that the package will move up the incline, (b) the velocity of the package as it returns to its original position, (c) the total amount of energy dissipated due to friction.

(Ans : 36.5 m , V = 12 m/s)



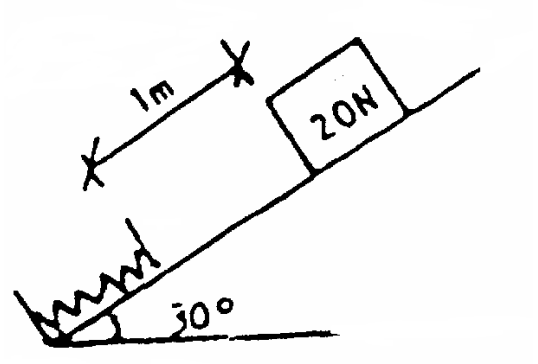
20. A 7.25 Kg mass slides 150mm from, rest down the 25° plane as shown in the Fig. it hits spring whose K is 1750 N/m. If the coefficient of kinetic friction is 0.20 find the maximum compression of the spring.

(Ans : 64.9 mm)



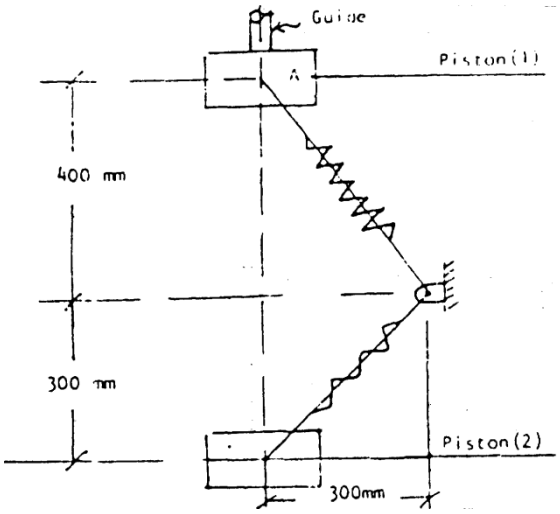
21. 20 N block slides with initial velocity 2 mIs down an inclined plane on to a spring of modulus 1000 N/m for a distance of 1m. Find maximum compression of the spring neglecting and considering friction.

(Ans : 0.166m, 0.178m)



22. A 10 kg collar slides without friction along a vertical rod. The spring has a constant K = 500 N/M & has a free length of 100 mm. If the collar is released from rest in position 1, find its velocity after it has moved 150 mm to position 2.

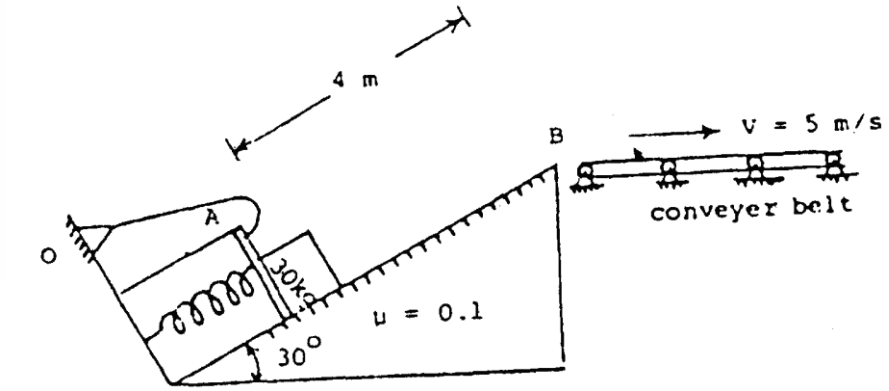
(Ans : 4.06 m/s)



23. A pre-compressed spring compressed to 0.2 m is held by a latch mechanism OA as shown in Fig. When the latch is released the spring propels a 30 Kg machine part which is being heat treated a A up the inclined plane onto a conveyer belt at B. The

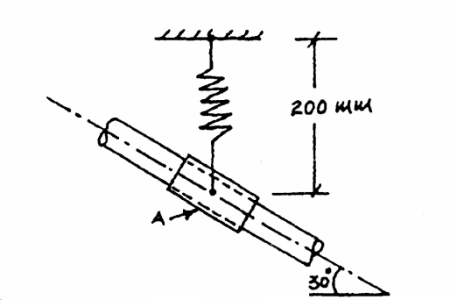
coefficient of friction between machine part and Incline is 0.1. The desired speed of machine part when it reaches the top of incline is 5 m/s. Find the spring constant K in KN/m that engineer must use. Angle of inclination of plane is 30º with horizontal.

(Ans : 53.277 KN/M)



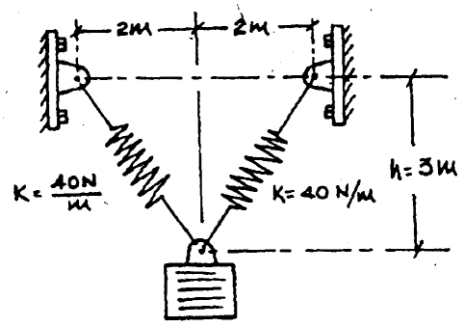
24. A collar A having a mass of 5 Kg can slide without friction on a pipe. If released from rest position shown where the spring is unstretched, what speed will the collar have after moving 50 mm? K = 2 KN /M.

(Ans : 0.393 m/s)



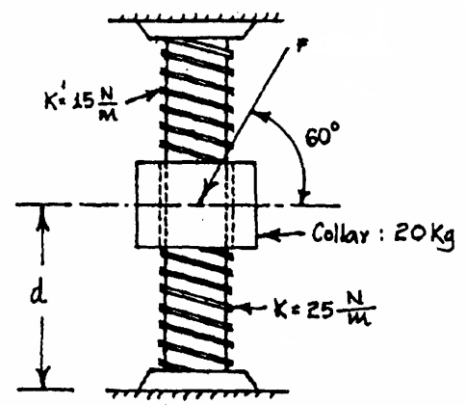
25. The cylinder has a mass of 20 Kg and is released from rest when h = 0. Determine its speed when h = 3m. The springs each have an unstretched length of 2m.

(Ans : 6.964 m/s)



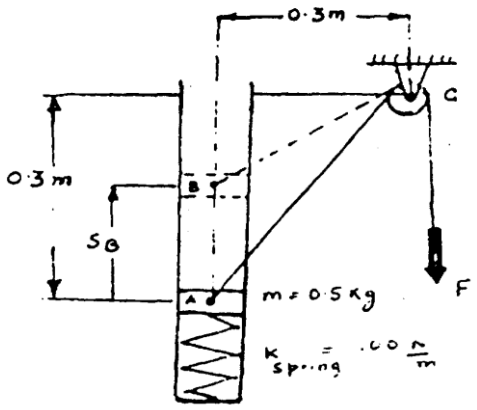
26. Figure shows a collar of mass 20kg which is supported on the smooth rod. The attached springs are undeformed when d = 0.5 m. Determine the speed of the collar after the applied force of F = 1000 N causes it to displace so that d = 0.3 m. The collar is at rest when d = 0.5 m.

(Ans : 4.6 m/s)



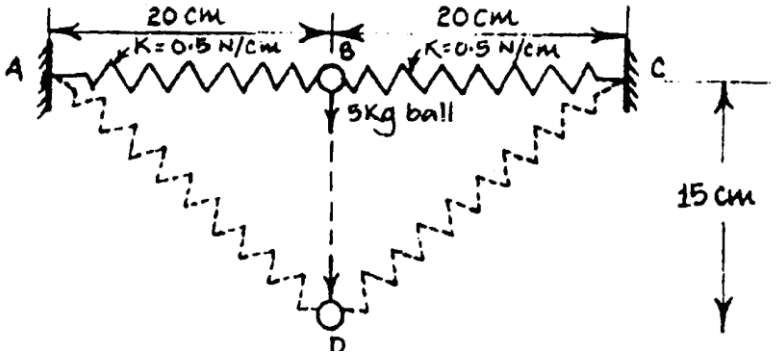
27. The block of mass 0.5 kg moves within the Smooth Vertical Slot. If it starts from rest, when the attached spring is in the unstretched position at A. determine the constant vertical force F which must be applied to the cord, so that block attains a speed of V_B = 2.5 m/s, when it reaches B i.e. S_B = 0.15 m. Neglect the mass of cord and pulley. K = 100 N/M .

(Ans : 38.46 N)



28. Two springs each having stiffness of 0.5 N/cm are connected to ball B having a mass of 5 kg in a horizontal position producing initial tension of 1.5 N in each spring. If the ball is allowed to fall from rest what will be its velocity after it has fallen through a height of 15cm.

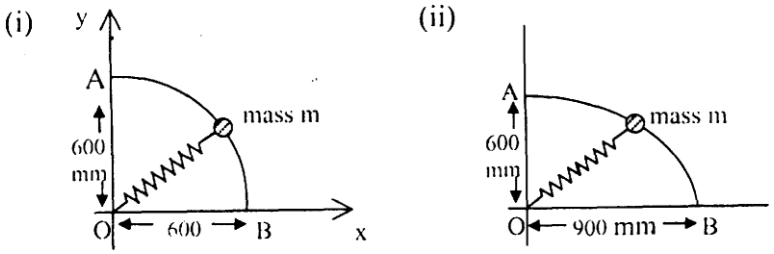
(Ans : 1.683 m/s)



29. The mass = 1.8 kg slides from rest at A along the frictonless rod bent into a quarter circle. The spring with modulus k = 16 N/m has an unstretched length of 400 mm.

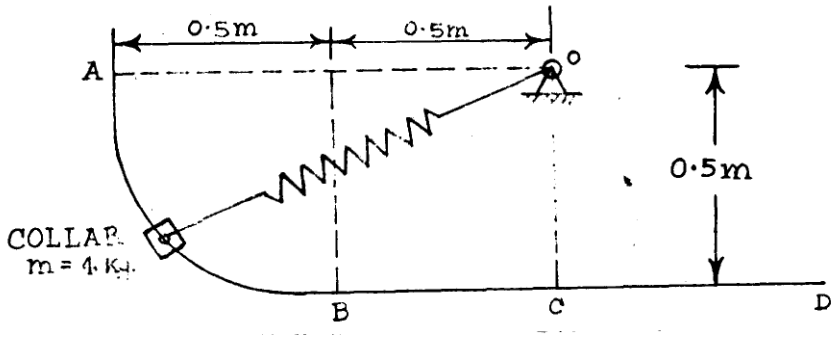
(i) Determine the speed of m at B. (ii) If the path is elliptical, what is the speed at B.

(Ans : (i) 3.43 m/s (ii) 3.15 m/s)



30. A 4 Kg collar is attached to a spring, slides on a smooth bent rod ACD. The spring has constant k = 500 N/m and is undeformed when the collar is at 'C'. If the collar is released from rest at 'A' determine the velocity of collar, when it passes through 'B' and 'C'. Also find the distance moved by collar beyond 'C' before to rest again.

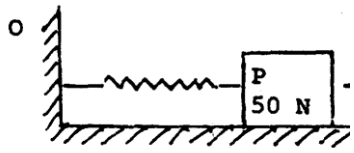
(Ans : V_B = 6 m/s, V_C = 6.43 m/s, 0.952 m)



31. In the figure the block P of weight 50 N is pulled so that the extension in the spring is 10 cm. The stiffness of the spring is 4N/cm and the coefficient of friction

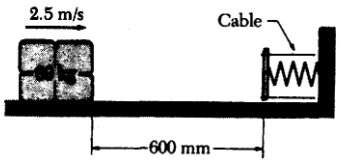
between the block and the plane Ox is μ = 0.3. Find i) the velocity of the block as the spring returns to its undeformed state. ii) The maximum compression in the spring.

(Ans : V_B = 0.443 m/s , 0.025 m)



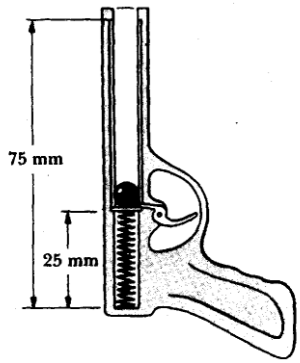
32. A spring is used to stop a 60-kg package which is sliding on a horizontal surface. The spring has a constant k = 20 KN/m and is held by cables so that is initially compressed 120 mm. Knowing that the package has a velocity of 2.5 m/s in the position shown and that the maximum additional deflection of the spring is 40 mm, determine (a) the coefficient of kinetic friction between the package and the surface, (b) the velocity of the package as it passes again through the position shown.

(Ans : μ = 0.2 , V = 1.11 m/s)



33. A toy spring gun is used to shoot 30-g bullets vertically upward. The undeformed length of the spring is 150 mm; it is compressed to a length 25 mm when the gun is ready to be shot and expands to a length of 75 mm as the bullet leaves the gun. A force of 50 N is required to maintain the spring in firing position when the length of the spring is 25 mm. Determine (a) the velocity of the bullet as it leaves the gun, (b) the maximum height reached by the bullet.

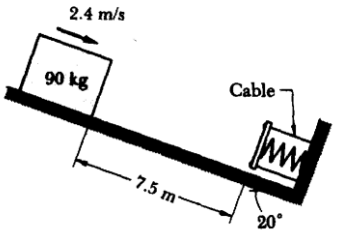
(Ans : 11.51 m/s, 10.57 m)



34. A spring is used to stop a 90-kg package which is moving down a 20º incline. The spring has a constant k = 22 KN/m and is held by cables so that it is initially

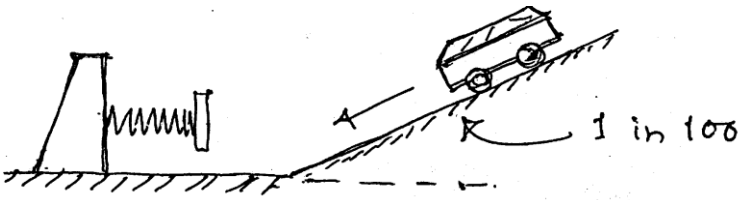
compressed 150 mm. Knowing that the velocity of the package is 2.4 m/s when it is 7.5 m from the spring and neglecting friction, determine the maximum addition deformation of the spring in bringing the package to rest.

(Ans : 0.362 m)



36. A wagon weighing 490 KN starts from rest runs 30 m down on inclined surface and strikes a post. If the rolling resistance of the track is 5N / KN, find the velocity of wagon when it strikes the post. If the impact is to be cushioned by means of bumper spring having k = 14.7 KN/mm, determine the compression of the bumper spring.

(Ans : 0.01 m)



37. The 10-kg slider A moves with negligible friction up the inclined guide. The attached spring has a stiffness of 60 N/m and is stretched 0.6 m in position A where the slider is released from rest. The 250 N force is constant and the pulley offers negligible resistance to the motion of the cord. Calculate the velocity v of the slider as it passes point C.

(Ans : 3.57 m/s)