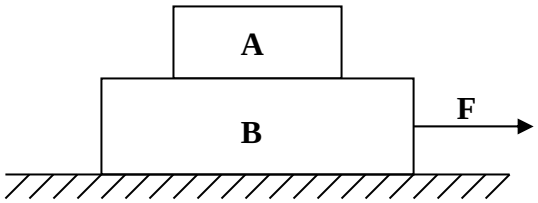
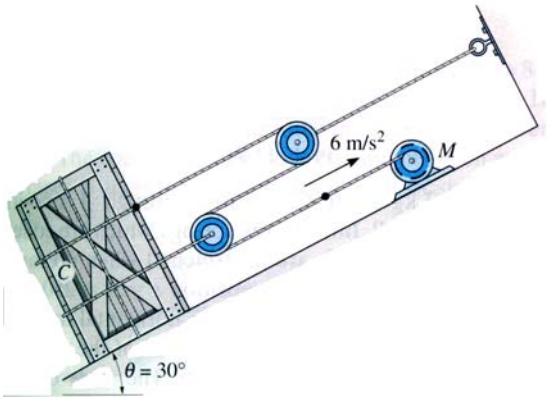
CE 222 ENGINEERING MECHANICS II (SPRING 2014 – 2015)
Home Exercise II – Kinetics of particles (Equation of motion, Work and Energy)
(http://www2.ce.metu.edu.tr/~ce222)

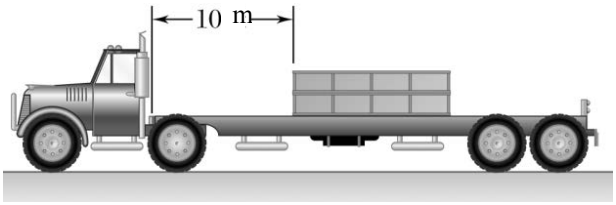
1. The masses m_A=15 kg, m_B=30 kg and the coefficients of friction between all surfaces are $\mu_S = 0.4$, $\mu_K = 0.35$. What is the largest force F that can be applied without causing A to slip relative to B? What is the resulting acceleration?



2. The motor M pulls in its attached rope causing an acceleration of 6 m/s^2. Determine this towing force.The coefficient of kinetic friction between the 50 kg crate and the plane is $\mu_K = 0.3$. Neglect the mass of the pulleys and rope.

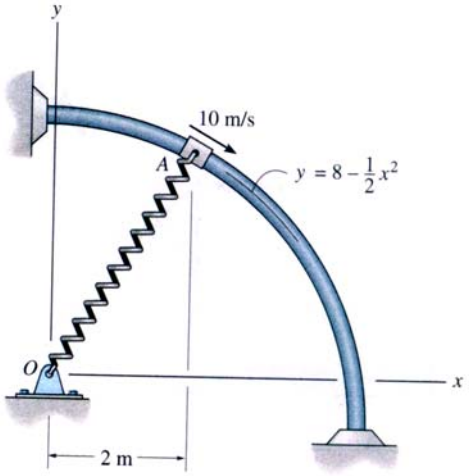


3. The coefficients of friction between the load and the flat-bed trailer shown are μ_s =0.40 and $\mu_k = 0.30$. Knowing that the speed of the rig is 72 km/h, determine the shortest distance in which the rig can be brought to a stop if the load is not to shift.

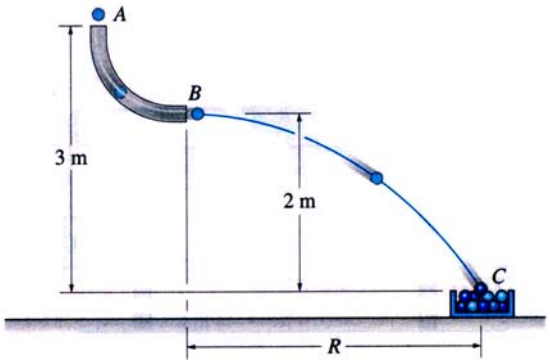


4. The 5 kg collar slides on the smooth rod, so that when it is at A it has a speed of 10 m/s. If the spring to which it is attached has an unstretched length of 3m and a stiffness of k=98.1 N/m, determine the normal force on the collar and the acceleration of the collar at this instant.

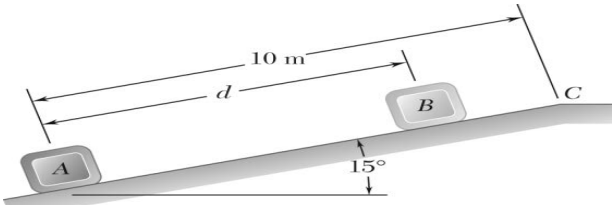
$$\rho = \frac{\left[1 + (dy/dx)^2\right]^{3/2}}{\left|d^2y/dx^2\right|}$$



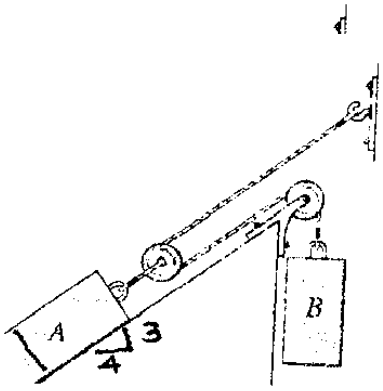
5. Marbles having a mass of 5 g fall from rest at A through the glass tube and accumulate in the can at C. Determine the placement R of the can from the end of the tube and the speed at which the marbles fall into the can. Neglect the size of the can.



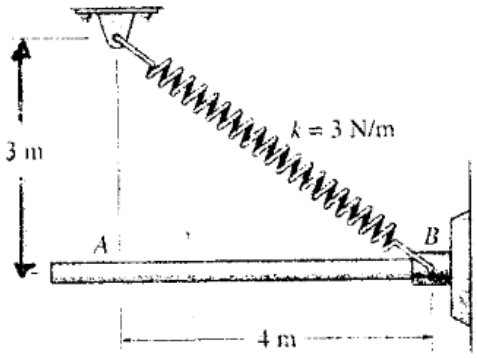
6. A package is projected up a 15° incline at *A* with an initial velocity of 8 m/s. Knowing that the coefficient of kinetic friction between the package and the incline is 0.12, determine
(*a*) the maximum distance *d* that the package will move up the incline,
(*b*) the velocity of the package as it returns to its original position. The maximum velocity attained by the blocks,



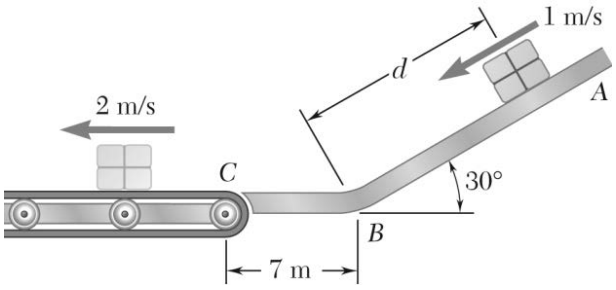
7. Block A has a weight of 300 N and block B has a weight of 50 N. If the coefficient of kinetic friction between the block and incline is μ_k=0.2, determine the speed of block A after it moves 1 m down the plane, starting from rest. Neglect the mass of the cord and pulleys.



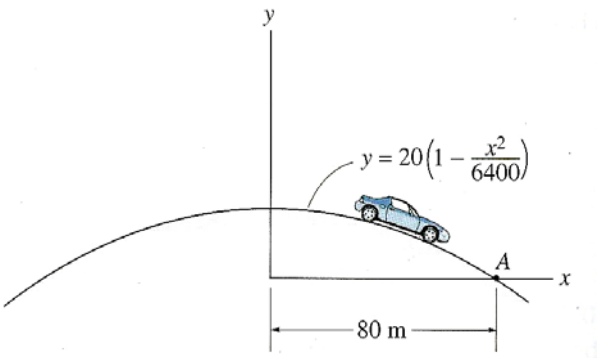
8. The 2-kg smooth collar is attached to a spring that has an unstretched length of 3 m. If it is drawn to point B and released from rest, determine its speed when it arrives point A.



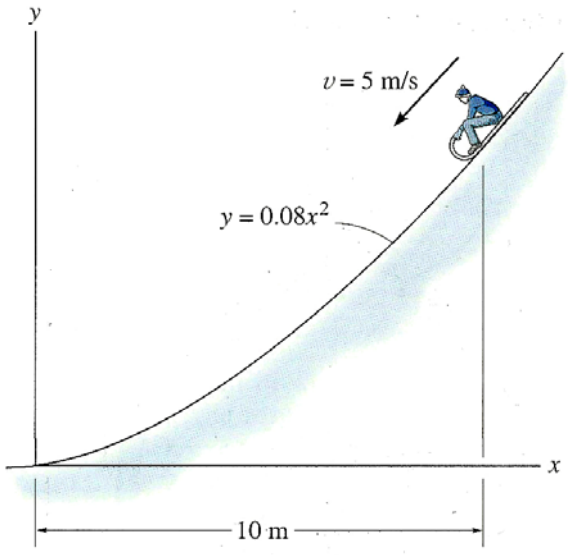
9. Packages are thrown down an incline at *A* with a velocity of 1 m/s. The packages slide along the surface *ABC* to a conveyor belt which moves with a velocity of 2 m/s. Knowing that μk =0.25 between the packages and the surface *ABC*, determine the distance *d* if the packages are to arrive at *C* with a velocity of 2 m/s.



10. The 0.8-Mg car is traveling over the hill having the shape of a parabola. If the driver maintains a constant speed of 9 m/s, determine both the resultant normal force and the resultant frictional force that all the wheels of the car exert on the road at the instant it reaches point *A*. Neglect the size of the car.

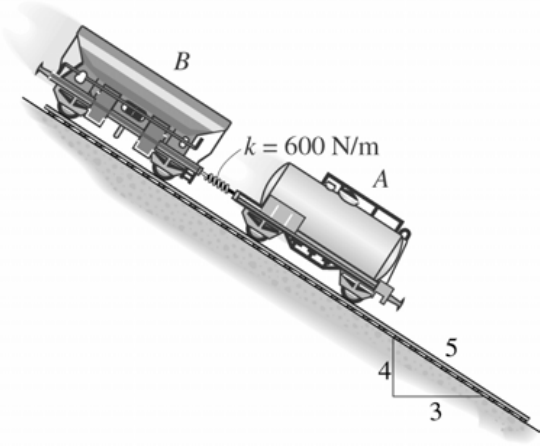


11. A toboggan and rider have a total mass of 90 kg and travel down along the (smooth) slope defined by the equation $y = 0.08x^2$. At the instant x = 10 m, the toboggan's speed is 5m/s. At this point, determine the rate of increase in speed and the normal force which the toboggan exerts on the slope. Neglect the size of the toboggan and rider for the calculation.

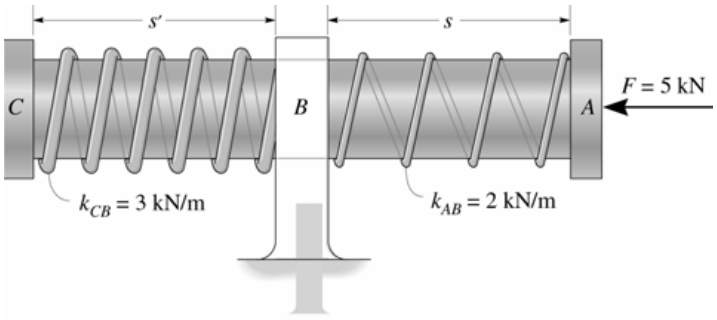


12. The 800-kg car at B is connected to the 350-kg car at A by a spring coupling. Determine the stretch in the spring if

a) The wheels of both cars are free to roll,
b) Car B applies brakes to all four wheels.
Take μ_B=0.4. Neglect the mass of the wheels.

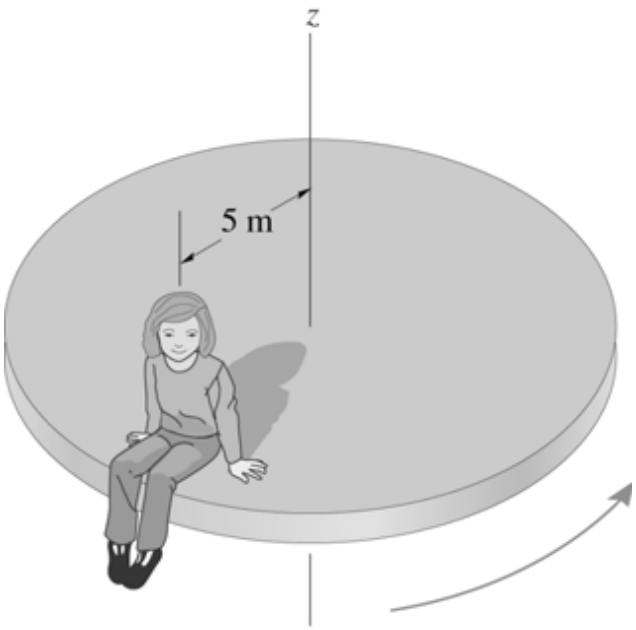


13. The 2-kg shaft CA passes through a smooth journal bearing at B. Initially the springs which are coiled loosely around the shaft, are unstretched when no force is applied to the shaft. In this position, s=s'=250 mm and the shaft is originally at rest. If a horizontal force of F=5 kN is applied, determine the speed of the shaft at the instant s= 50 mm and s'=450 mm. The ends of the springs are attached to the bearing at B and the caps at C and A.

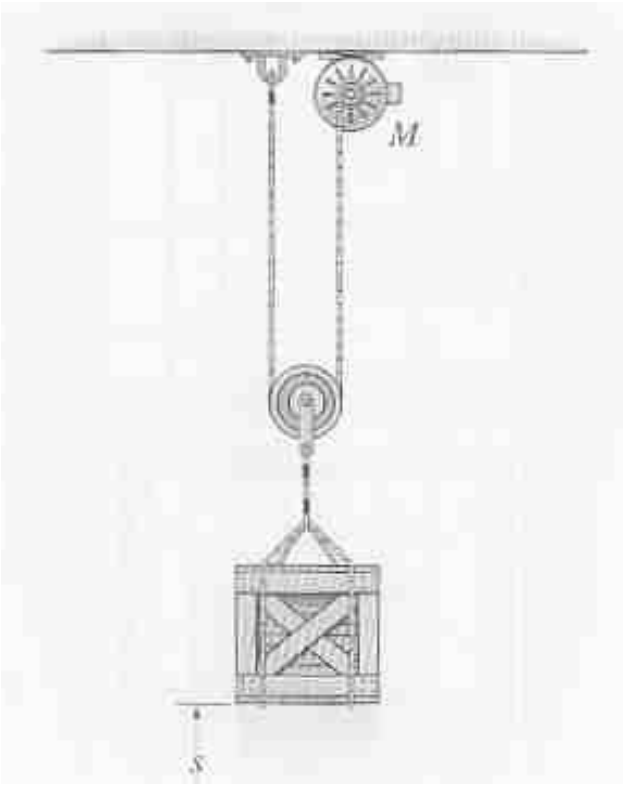


14. A girl having a mass of 15-kg, sits motionless relative to the surface of a horizontal platform at a distance of r = 5 m from the platform's center. If the angular motion of the platform is slowly increased so that the girl's tangential component of acceleration can be neglected, determine the maximum speed which the girl will have before she begins to slip off the platform. The coefficient of static friction between the girl and the platform is μ_k=0.2.

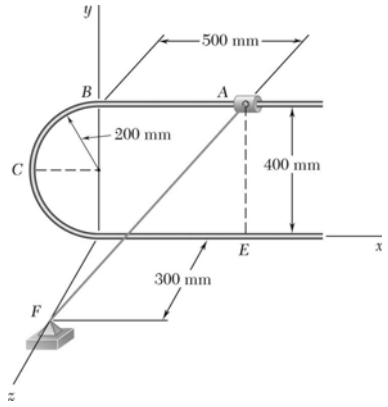
b) Solve the same problem by assuming that the platform starts rotating from rest so that the girl's speed is increased uniformly at $\dot{v} = 0.5\ \text{m/s}^2$.



15. The 50-N (= 5-kg) crate is hoisted by the motor M. If the crate starts from rest and by constant acceleration attains a speed of 12 m/s after rising s= 10m, determine the power that must be supplied to the motor at the instant s=10m. The motor has an efficiency Ɛ=0.65. Neglect the mass of the pulley and cable.



16. A 1-kg collar can slide along the rod shown. It is attached to an elastic cord anchored at *F*, which has an undeformed length of 250 mm and a spring constant of 75 N/m. Knowing that the collar is released from rest at *A* and neglecting friction, determine the speed of the collar
(*a*) at *B*,
(*b*) at *E*.



17. 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.