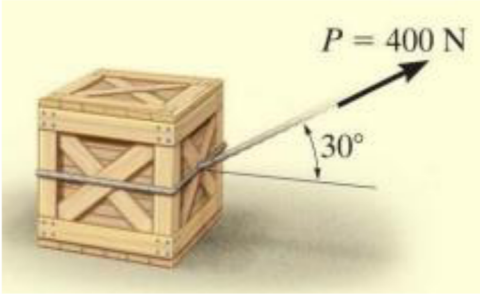
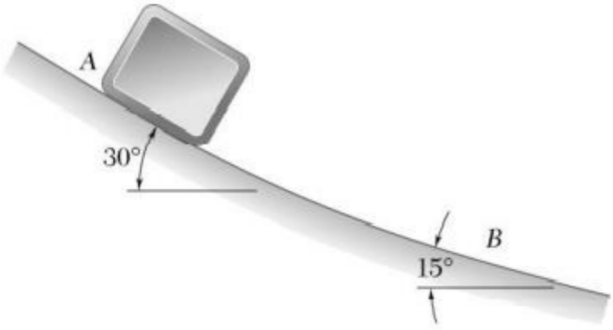
Module 5 Part 1 Kinetics I (Newton law)

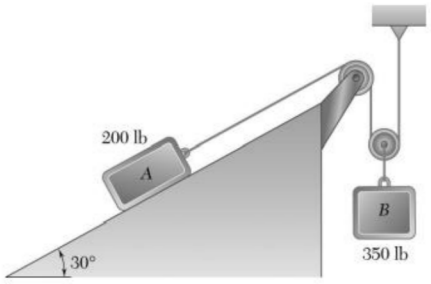
1.The 50-kg crate shown in Fig. rests on a horizontal surface for which the coefficient of kinetic friction is μk = 0.3. If the crate is subjected to a 400-N towing force as shown, determine the velocity of the crate in 3 s starting from rest.



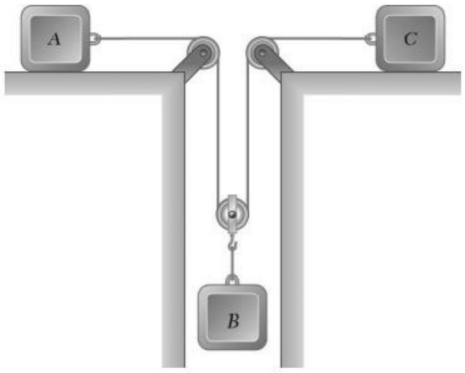
2. The acceleration of a package sliding at Point A is 3 m/s^2 . Assuming that the coefficient of kinetic friction is the same for each section, determine the acceleration of the package at Point B.



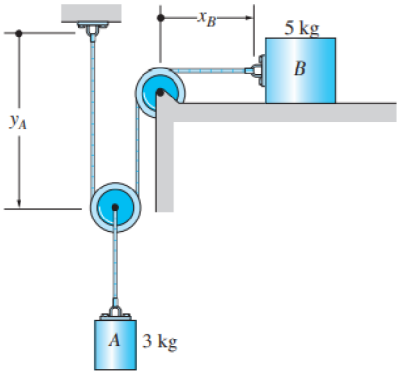
3. The two blocks shown are originally at rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between block A and the incline, determine (a) the acceleration of each block, (b) the tension in the cable.



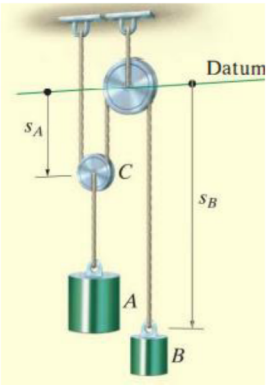
4. The coefficients of friction between blocks A and C and the horizontal surfaces are μ_k = 0.2.Knowing that m_A = 10 kg, m_B = 10 kg and m_C =5kg determine (a) the tension in the cord, (b) the acceleration of each block.



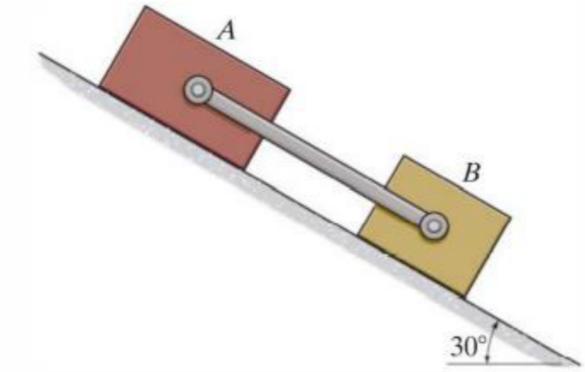
5. The blocks A and B are connected by a cable that runs around two pulleys of negligible weight. Determine the time required for A to reach a speed of 2 m/s after the system has been released from rest. Neglect friction.



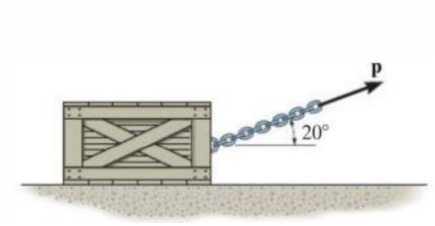
6. The 100-kg block A shown in Fig. is released from rest. If the masses of the pulleys and the cord are neglected, determine the speed of the 20-kg block B in 2 s.



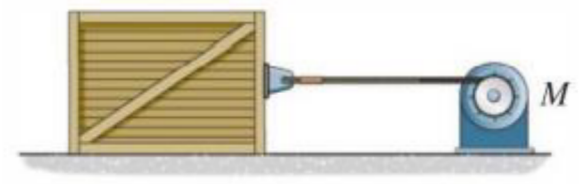
7. If blocks A and B of mass 10 kg and 6 kg, respectively, are placed on the inclined plane and released, determine the force developed in the link. The coefficients of kinetic friction between the blocks and the inclined plane are $\mu_A = 0.1$ and $\mu_B = 0.3$. Neglect the mass of the link.



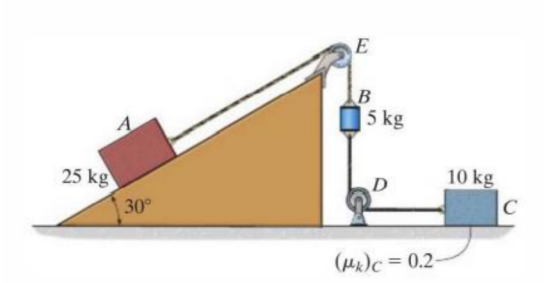
8. The crate has a mass of 80 kg and is being towed by a chain which is always directed at 20° from the horizontal as shown. Determine the crate's acceleration in t = 2 s if the coefficient of static friction is μs= 0.4, the coefficient of kinetic friction is μk = 0.3, and the towing force is P = ($90t^2$) N, where t is in seconds.



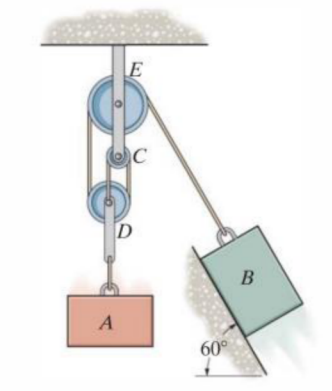
9. If motor M exerts a force of F = ($10t^2$ + 100) N on the cable, where t is in seconds, determine the velocity of the 25-kg crate when t= 4 s. The coefficients of static and kinetic friction between the crate and the plane are μs = 0.3 and μk = 0.2S, respectively. The crate is initially at rest.



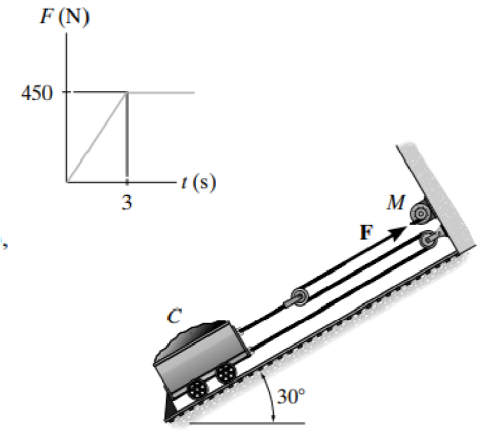
10. Determine the acceleration of the system and the tension in each cable. The inclined plane is smooth, and the coefficient of kinetic friction between the horizontal surface and block C is (μk)c = 0.2.



11. Determine the required mass of block A so that when it is released from rest it moves the 5-kg block B a distance of 0.75 m up along the smooth inclined plane in t = 2 s. Neglect the mass of the pulleys and cords.



12. If the force of the motor M on the cable is shown in the graph, determine the velocity of the cart when the load and cart have a mass of 200 kg and the car starts from rest.



13. Two blocks A and B interconnected by a short string, slide down a plane inclined at an angle of 30° with respect to the horizontal. The block A weighs 400 N and the coefficient of friction between block A and the plane is 0.1. The block B which follows A weighs 300 N and the coefficient of friction between block B and the plane is 0.2. Determine. i) the force in the string and ii) the velocity of the system at the end of 4 sec. assuming the system to start from rest.

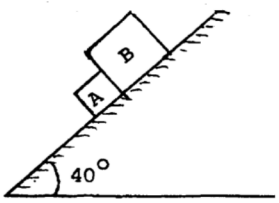
(Ans : a = 3.69 m/s² , T = 14.81 N , V = 14.76 m/s)

14. Two weights P_1= 400 N & P_2 = 100 N are connected by a string and move along a horizontal plane under the action of force Q = 200 N applied horizontally to the weight P1. The coefficient of friction between the weights and the plane is 0.25. Determine the acceleration of the weights and the tension in the string. Will the acceleration and tension in the string remain same if the weights are interchanged?

(Ans : (i) a = 1.47 m/s² , T = 40 N (ii) a = 1.47 m/s² , T = 159.94 N)

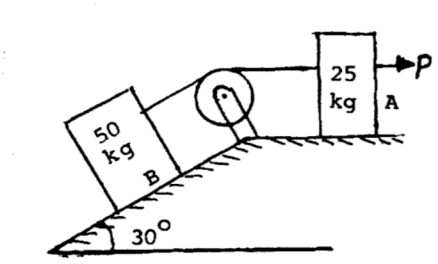
15. Refer fig Masses A and B are 7.5 kg and 27.5 kg respectively. Assume the coefficient of friction between A and the plane is 0.25 and between B and the plane is 0.1. What is the force between the two as they slide down the incline?

(Ans : a = 5.31 m/s² , T = 6.62 N)



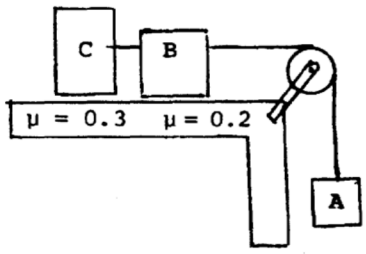
16. Determine the force P required to impart a velocity of 3m/sec after moving 5 m from rest to the system of connected bodies shown in the fig. Also determine the tension in the string connecting block A to block B. Take μ= 0.25 for all the rubbing surfaces. [Block A =25 kg, Block B =50 kg]

(Ans : P = 480.26 N , T = 396.45 N)



17. Fig. shows a dynamic system consisting of two blocks B (400 N) and C (500 N) connected by an inextensible string passing over a smooth pulley and carrying a weight A (300 N). If the coefficient of friction between the rough horizontal surfaces of table is 0.2 with block B and 0.3 with block C, determine the velocity of the block A, 10 seconds after starting from rest. Determine the tension in string in portion BC.

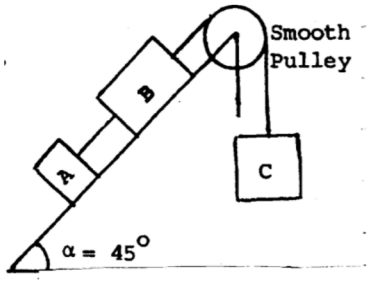
(Ans : a = 0.57 m/s² , T_{AB} = 282.57 N , T_{BC} = 179.1 N)



18. Three bodies A, B,C of weights 100 N, 200N and 300N respectively are connected by inextensible string passing over a smooth pulley as shown in the fig. The coefficient of friction between block A and plane is 0.1 and that between Block B and plane is 0.2. Find the acceleration of the bodies A, B and C if the system starts from rest Neglect the weight of the pulley.

Also find the tensions in the string between (i) A and B and (ii) B and C. Also find the time taken by body C to travel distance of 10m.

(Ans : a = 0.86 m/s² , T_{AB} = 86.55 N , T_{BC} = 273.7 N)

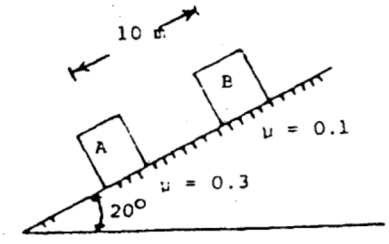


19. A vertical lift of total mass 750 Kg. acquires an upward velocity of 3 m/sec over a distance of 4m, moving with constant acceleration, starting from rest. Calculate the tension in the cable.

(Ans : a = 1.125 m/s² , T = 8201.25 N)

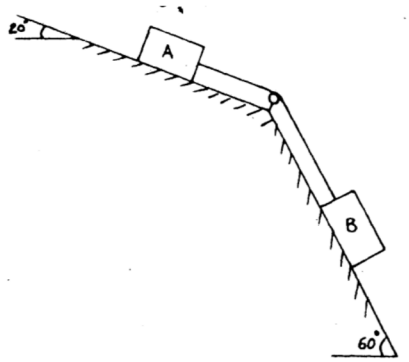
20. Two blocks A and B are held 8tationaiy 10 m apart on a 20° incline as shown in Fig. The co-efficient of dynamic friction between the plane and A is 0.3 where as between the plane and B is 0.1. If the blocks are released simultaneously, Calculate the time taken and distance traveled by each block before they are at the verge of collision.

(Ans : t = 3.31 sec, S_A = 3.29 m , S_B = 13.31 m)

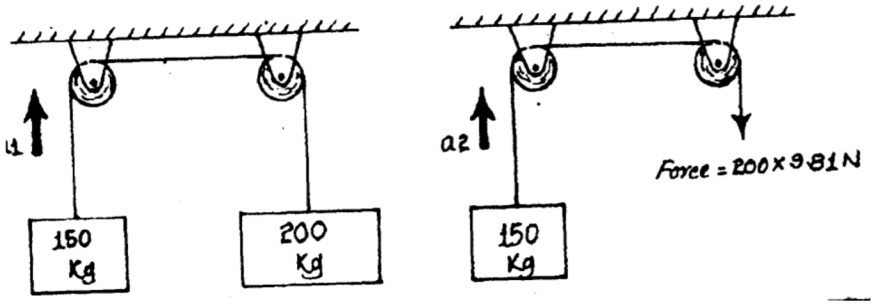


21. Blocks A and B are connected by an inextensible cord as shown. If both blocks are released simultaneously, what distance do they move in 0.5 sec. Take mass of A = 25 kg, mass of B = 35 kg and μ = 0.3 for both blocks.

(Ans : a = 4.34 m/s² , T = 93.76 N , S = 0.54 m)



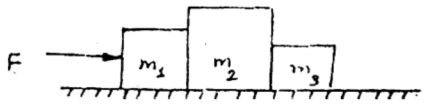
22. Find the ratio of accelerations a1 /a2 of the 150 kg mass when it is connected as shown in the figures.



(Ans : 0.429)

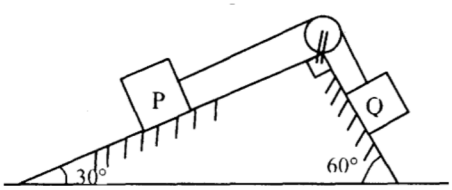
23. Three blocks m_1, m_2 and m_3 of masses 1.5 kg. 2 kg and 1 kg respectively are placed on a rough surface (μ = 0.2) as shown in Figure. If a force F is applied so as to give the blocks acceleration of 3 mls^2, then what will the force that 1.5 kg block exerts on the 2 kg block.

(Ans : F = 22.23 N, F_{12} = 14.89 N)



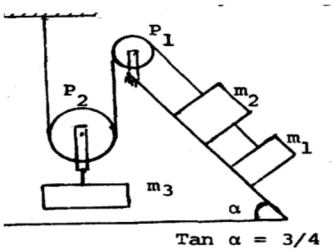
24. Two blocks P and Q of mass 8 kg and 24 kg respectively are connected by a weightless rope passing over a frictionless pulley as shown in the figure. Determine the velocity of the system 3 seconds after starting from rest. Take the coefficient of friction for all surfaces μ = 0.30.

(Ans : a = 3.41 m/s² , T = 86.74 N, V = 10.23 m/s)



25. Fig shows two masses m_1 = 1 Kg & m_2 = 2 Kg connected by rope & rope passing over two smooth pulleys P_1 & P_2 Mass m_3 = 5 Kg is supported from the movable pulley P_2. If the inclination of the inclined plane is α , where tan α = 3/4 and coefficient of friction is 0.1, determine the motion of the system, neglecting the weight of pulley P_2.

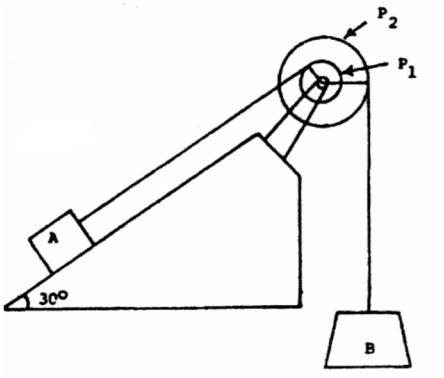
(Ans : T = 23.21 N , a_1 = 1.06 m/s^2, a_2 = 0.53 m/s^2)



26. A frictionless step pulley, mounted at the top of an incline supports a block A restrained to slide over the incline and block B hanging from it shown in fig.

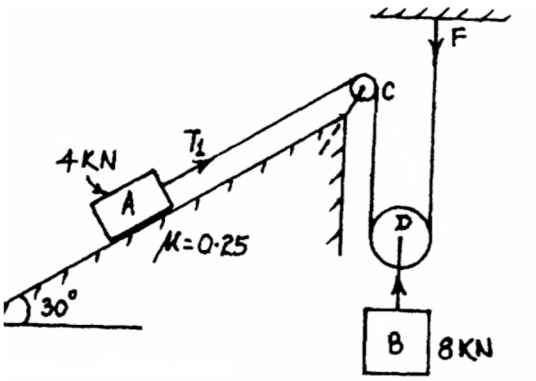
If the block A of mass 3 Kg accelerates at 2 m/s^2 up the inclined plane, determine the mass of block B. Take μ = 0.3. The diameters P_1 and P_2 of the step pulley are 40 mm and 80 mm respectively.

(Ans : 2.488 Kg)



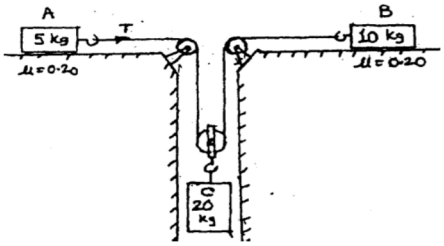
27. A block of weight 4 KN is being pulled up the inclined plane by using another block B of weight 8 KN as shown in the figure. Determine (i) acceleration of block A, (ii) Acceleration of block B, (iii) Tension T_1 in cord attached to block A. (iv) Tension T_2 in cord attached to Block B. Take coefficient of friction between block A and inclined plane as 0.25. Assume cords as inextensible and pulleys at C and 0 are small, frictionless and negligible mass.

(Ans : a_A = 2.137 m/s² , T = 3564.273 N)



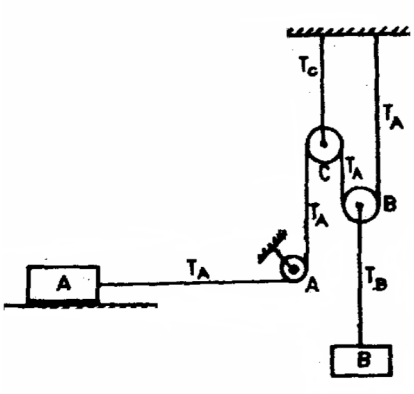
28. Masses A (5kg), B (10kg), C (20kg) are connected as shown in the figure by inextensible cord passing over massless and frictionless pulleys. The coefficient of friction for masses A and B and ground is 0.20. If the system is released from rest, find the acceleration a_A, a_B & a_C and tension T in the cord.

(Ans : T = 47.04 N , a_A = 7.448 m/s² , a_B = 2.774 m/s² , a_C = 5.096 m/s²)



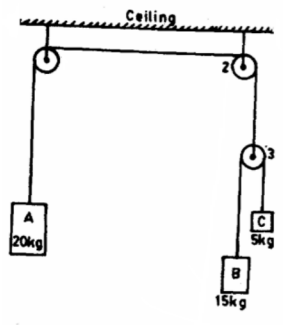
29. Two bodies A and B as shown in the Fig. are having masses 25kg and 15kg respectively. Find the speed of the Body- B 1 sec after the system is released from rest. Coefficient of kinetic friction for the contact surfaces of body A and the horizontal surface is 0.2. Also find tensions T_A, T_B and T_C and the thrust T_D. Assume pulleys weightless and frictionless.

(Ans : a_A = 0.852 m/s² , a_B = 0.426 m/s² , T_A = 70.31N , T_B = 140.61 N = T_C, T_D = 99.426 N)



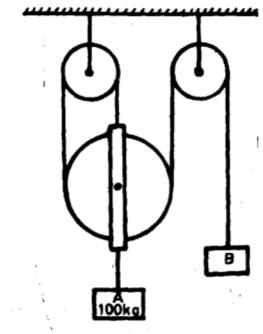
30. Find the tension in the rope & acceleration of masses.

(Ans : a_A = 1.4 m/s² ↓, a_B = 4.2 m/s²↓, a_C = 7 m/s² ↑, T = 84 N)



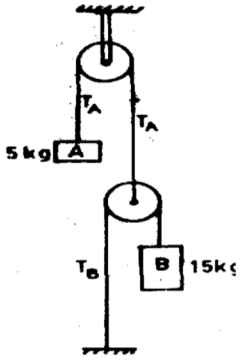
31. If acceleration of A is 1.8 m/s² (upwards), Determine (i) Mass of block-B (ii) corresponding tension in the cable.

(Ans : 87.88 Kg, T = 386.67 N)



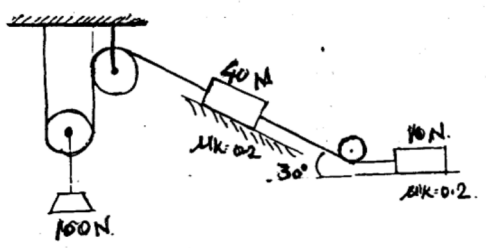
32. A system of two masses, as shown in the Fig. is released from rest. Mass-A is of 5 kg and mass B is of 15 kg. Find the acceleration of each mass and tension in each cord.

(Ans : a_A = 3.77m/s², a_B = 7.54m/s², T_A = 67.846N, T_B = 33.923N)



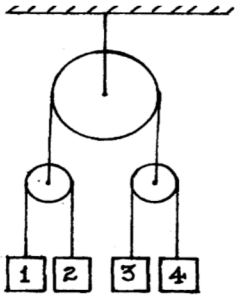
33. Determine the acceleration of a 100 N weight shown below after the motion has begun. Also calculate the tensions in the spring. Assume the pulleys frictionless.

(Ans :



34. In the system shown in the fig the pulleys are to be considered massless and frictionless. The masses in kg are the numbers 1, 2, 3 and 4. Determine the acceleration of each mass and the tension in the fixed cord.

(Ans : T = 76.8N, a_1 = 9.2m/s²↑, a_2 = 0.4m/s² ↓, a_3 = 3.6m/s² ↓, a_4 = 5.2m/s² ↓)



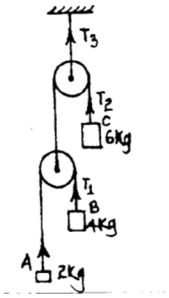
35. In the system of pulleys, masses and connecting inextensible cables. Shown in the figure, the pulleys and cables are considered massless and frictionless. Mass of A = 2 kg, mass of B = 4 kg and mass of C = 6 Kg .

If the system is released from rest find:

(1) tension in each of the three cables.

(ii) acceleration of each of the three masses.

(Ans : a_A = 4.04m/s² ↑, a_B = 2.89m/s² ↓, a_C = 5.77m/s² ↓, T = 47.09)

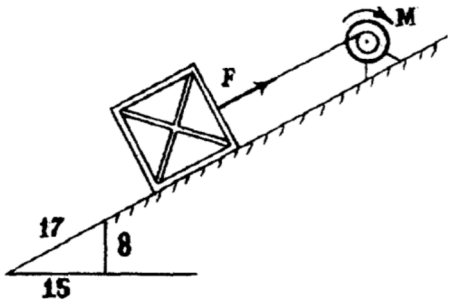


36. A particle of mass 1 Kg moves in a straight line under the influence of a force which increases linearly with time at the rate of 60 N/sec, initially it being 40 N. Determine position, velocity and acceleration after 5 seconds from rest from origin.

(Ans : S = 1750 m, V = 950 m/s, a = 340 m/s²)

37. The 100 kg crate is hoisted up by the incline using the cable and motor M. For a short time, the force in the cable is $F= 800t^2$ N where t is in seconds. If the crate has an initial velocity V_1= 2 m/s when t = 0 seconds determine the velocity when t =2 seconds. The coefficient of kinetic friction between the crate and incline is μ_k = 0.3.

(Ans : 8.91 m/s)



38. An air plane has a mass of 25000 kg and its engines develop a total thrust of 40 KN along the runway. The force of air resistance to motion of air plane is given by D = 2.25 V², where V is in m/s and D is in Newtons. Determine the length of runway required if the plane takes off and becomes airborne at a speed of 240 KPH.

(Ans : 1.598 KM)