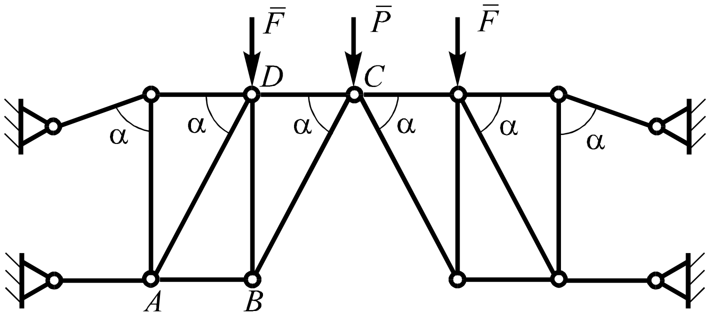
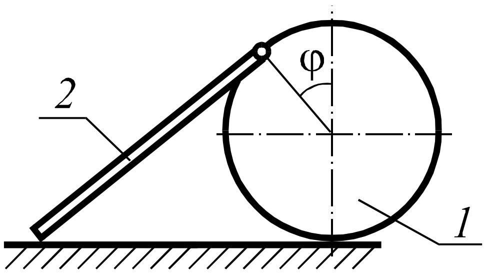
Problem S1 – 2010 (8 points)



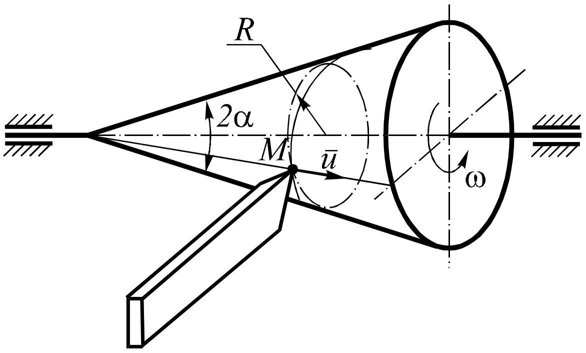
In the depicted rod construction all rods are weightless. Find at what proportion of the internal forces F and P in the rods AB and CD are 5 times different. $\alpha = 60°$.

Problem S2 – 2010 (7 points)



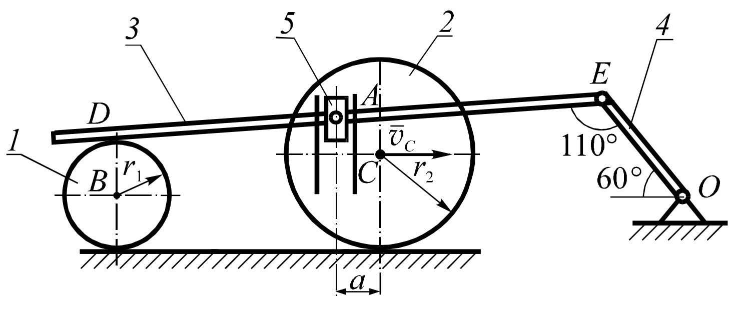
The homogeneous disc with the mass m_1 and the radius R is hinged to the homogeneous rod with the mass m_2 and the length l. Define the minimal constant of friction between the bodies and the surface when the system is in equilibrium in the position defined by the angle φ.

Problem K1 – 2010 (7 points)



The lathe tool is doing translational displacement along the cone with the constant velocity $\bar{u}$. Define the radius of motion path curvature for the tool point M in regard to the cone in the place where its radius is R. The cone is uniformly rotating with the angular velocity ω on the fixed axis and the vertex cone angle is 2α.

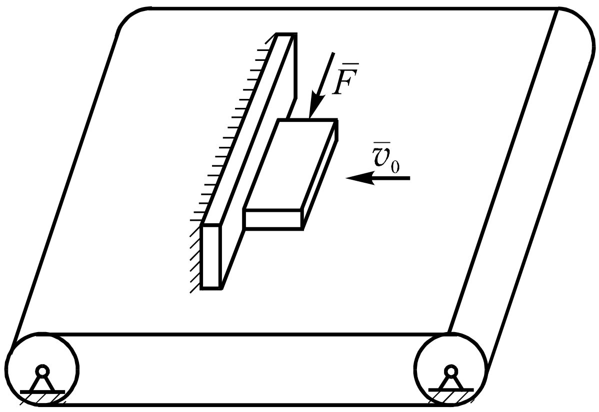
Problem K2 – 2010 (8 points)



The planar mechanism consists of the rollers 1 and 2 with the radii r_1 =30 cm and r_2 =50 cm the hinged rods 3, 4 and the slider 5 hinged to the rod 3. The slider 5 is moving in the channel of the roller 2 (a = 25 cm). Define the speed v_B of the roller centre B and the angular velocity ω_4 of the link 4 if the speed of the roller centre C is v_C. There are no slips of the rollers 1 and 2 relative to the supporting surface as well as the roller 1 relative to the rod 3 (they contact in point D). In such position $DA = AE$ = 60cm.

***Note**: No need to calculate the numerical values for trigonometrical functions, formulation as sin 35° is enough.*

Problem D1 – 2010 (6 points)

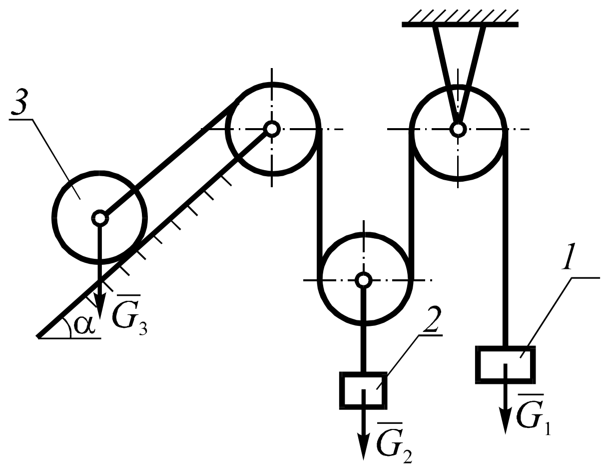


The load with the mass m on the conveyor belt is moving crosswise under the constant force F. The immovable barrier interferes with the lengthway movement of the load. The coefficient of friction between the load and the belt is f_1, between the load and the barrier is f_2. The speed of the belt is v_0.

1. Define the minimal force F_{min} when the motion is possible.

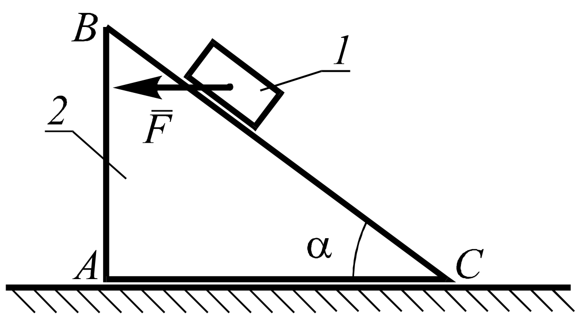
2. Find the maximum possible velocity of the load under the force $F = 2F_{min}$.

Problem D2 – 2010 (10points)



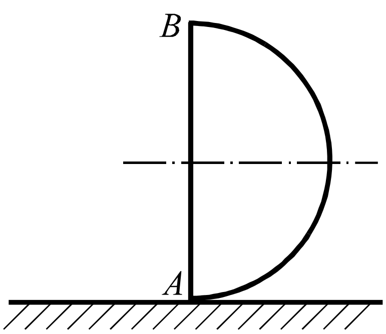
What is the weight of load G_1 in order that the load 1 is motionless in the mechanical system when $G_2 = 3G$, $G_3 = G$. Ignore the masses of unnumbered blocks, cables and friction in hinges. Consider the body 3 as a solid homogeneous disk. The coefficient of friction between the disk 3 and the surface is f. The angle α is given.

Problem D3 – 2010 (8 points)



The load 1 with the mass m_1 is sliding along the face of the prism 2 with the mass m_2 moving along the horizontal plane. The friction between the bodies is absent. The angle α is known. Find the minimal horizontal force F when the prism turn-over begins (i. e. the point C breaking-off from the surface).

Problem D4 – 2010 (6 points)



Find the maximum angular velocity and maximum angular acceleration for the homogeneous semi-cylinder with the radius r if at the initial moment its AB side is vertical and the semi-cylinder is motionless. Consider the rolling motion is without slipping.