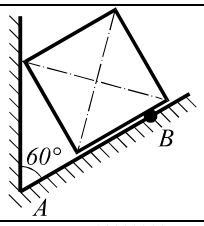
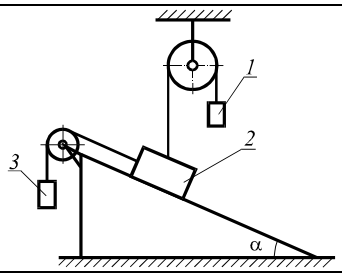
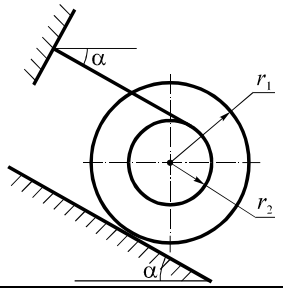
Statics



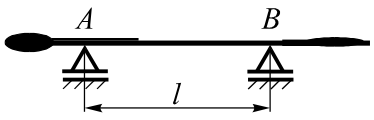
1. The cube is hold in equilibrium with the help of smooth vertical and inclined planes. Find *AB* distance from the vertex of the angle to the point of application of inclined plane reaction if the cube edge is 20 cm.



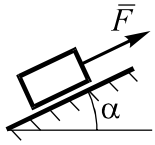
2. In the depicted system mass of bodies 2 and 3 are m_2 and m_3 respectively. Inclination of plane towards horizon is α. Neglecting friction find the mass of body 1 when the system is in equilibrium.



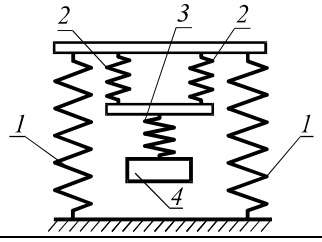
3. Find minimum value of friction coefficient when the roller with r_1 and r_2 radii is in equilibrium. Angle α is known.



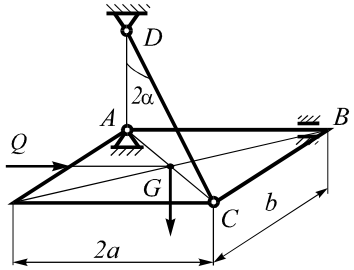
4. A nonhomogeneous rod lies on two smooth *A* and *B* supports. Constraint *A* force is twice as large as constraint *B* force. The distance between the supports is *l*. What maximal distance to the left can the right support be displaced at so that the rod remains in equilibrium?



5. On the plane with the horizontal angle α = 30° there is a load weighing 4 N. To the load the force F = 1,5 N parallel to the inclined plane has been applied. Friction coefficient is f = 0,5. Find the friction force between load and plane.

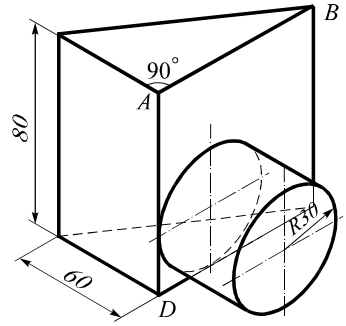


6. Load 4 is suspended to the system of springs which stiffness coefficients are c_1 = 1 kN/m; c_2 = 0,5 kN/m; c_3 = 1 kN/m. Find stiffness coefficient for the equivalent spring which can replace the depicted system.



7. Homogeneous rectangular plate with dimensions *2a, b* and weight *G* is hold in equilibrium by spherical hinge *A*, cylindrical hinge *B* and rod *CD* with the vertical angle 2α. Find the reaction of cylindrical hinge *B*.

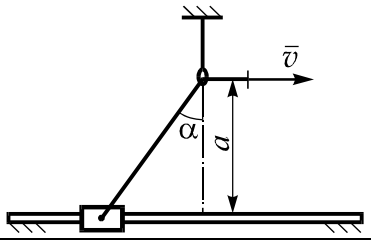
8. The triangle is composed from three homogeneous rods with *l* length each. One side has been removed. How far will the position of the centre of gravity for the figure change?



9. The homogeneous body with dimensions shown in the picture is being hanged up by edge *AB* so that it takes the horizontal position. What is the height of the cylinder *h* to be in order that *ABCD* plane is vertical?

10. At equilibrium 1/6 of rod length is above liquid surface. What is the liquid - rod densities ρ_l/ρ_r ratio?

Kinematics

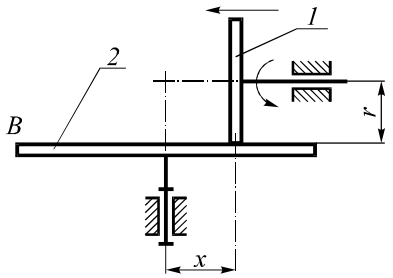


11. The cord put through the ringlet is fastened to the slide block which can move along the runners. The cord is chosen with v velocity. Find the velocity of the slide block when the cord is at the angle α with the vertical line.

12. At which second from the start of uniformly accelerated motion is the way passed by the point three times as long as the way passed at the previous second if the motion is without initial speed?

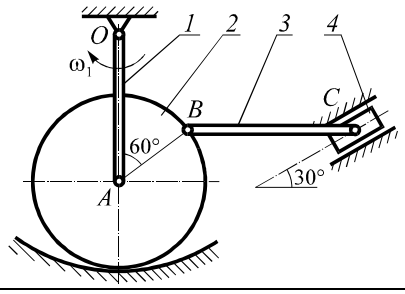
13. The disc begins to rotate with a constant deceleration. At start its angular velocity is 4π rad/s. Having done 10 revolutions the disk stopped. Find its angular acceleration.

14. The disk with radius 5 cm revolves in the way that its angular velocity changes under the law $\omega = \pi(6t - t^2)$ rad/sec. Find the maximal linear velocity for the point of the disk rim during this movement.

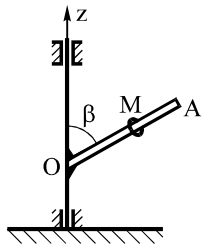


15. In a friction mechanism shaft 1 with radius r is revolving with uniform angular acceleration ε_1 and at the same time is moving in the line indicated by the arrow. According to which law of distance variation x disk 2 will be revolving with uniform angular velocity ω_2 if at the initial time $x_0 = a$?

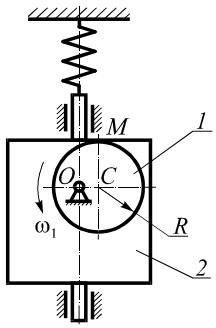
16. An automobile wheel is rolling on the surface slip-free. On wheel's surface point M is moving. Draw in the picture how the relative velocity vector of point M should be directed in order that Coriolis acceleration is absent.



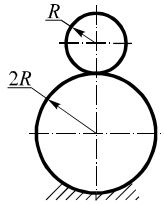
17. For the depicted position of the mechanism find how many times the speed of point C differs from the speed of point A?



18. Rod OA is revolving about axis z under the law $\varphi = \varphi_0 e^{-\alpha t}$ (φ_0 and α – constants). Ring M is moving along the rod, tilted to the vertical angle β. Define the law of relative speed change for the ring if its Coriolis acceleration is constant and it is a_k.



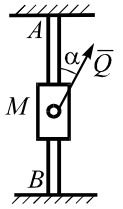
19. In the depicted position on the mechanism $\omega_1 = 5\dfrac{\text{rad}}{\text{sec}}$; $R = 5$ cm; $OC = 3$ cm. Find v_2.



20. A disk with radius R is rolling over a stationary disk with radius $2R$. The center of the small disc makes one complete revolution around the center of the large disk. How many times will the small disc turn around its axis?

Dynamics

21. Tram with $m = 20000$ kg weight rest on a horizontal track. Tractive force varying under law $F = 4000t$ N comes in action. Resisting forces interfere with the tram movement, and the average friction coefficient is $f = 0{,}02$. Find the speed of the tram at $t = 2$ sec.



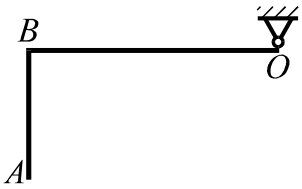
22. Slide block M with 20 kg weight is moving up with acceleration $a = 2$ m/sec^2 along the vertical rod AB under force Q directed on-the-miter $\alpha = 45°$ towards the rod. Find Q force if friction coefficient is $f = 0{,}2$.

23. A man is sitting on the verge of a horizontal platform with radius $R = 4$ m. How many revolutions per minute round a vertical axis should the platform do so that the man may not keep on it if friction coefficient is $f = 0{,}27$?

24. What acceleration has the centre of mass of a homogeneous cylinder rolling without slipping along an inclined plane with α angle towards horizon? Rolling resistance is neglected.

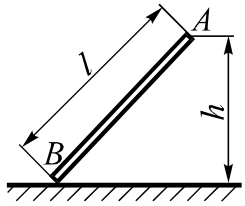
25. How many times is it necessary to turn up the motorship engine power to increase the speed twice as high as it was if the resistance of water movement increases in proportion to the square of the ship speed?

26. A load regarded as a material point is fastened to the free end of a weightless inextensible cable the other end of which is stationary. The load is disturbed from the stable equilibrium condition so that the cable is in the horizontal position and set free without an initial velocity. Define which cable angle to vertical that fits the maximal projection of the load velocity on the vertical axis in the process of movement.

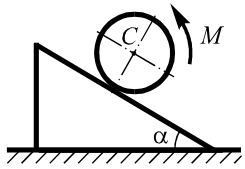


27. A homogeneous L-shaped rod of uniform cross-section with lengths of elements l and $2l$ is located on vertical plane so that its larger side is horizontal.

Find the rod angular acceleration in this position.



28. A homogeneous rod on a smooth horizontal floor with l length is set free without an initial velocity from the position where A point is at h height above the plane. Define B point horizontal movement towards the moment of A point contact with the floor.



29. A wheel is rolling with slipping along an inclined plane with α angle towards horizon under M turning moment applied. Find C wheel centre of mass acceleration if sliding friction coefficient is f.

30. The ball with m_1 weight moving at speed v_1 produces a non-elastic central impact on a motionless ball with m_2 weight. Find the sum of all forces work performed during the impact.