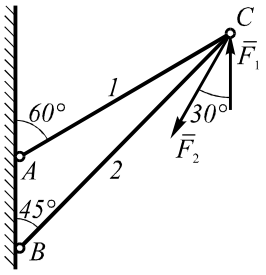
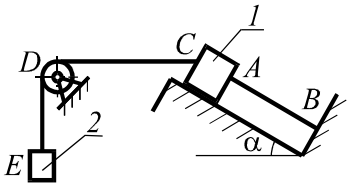
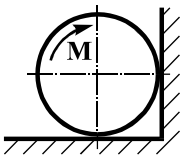
Statics



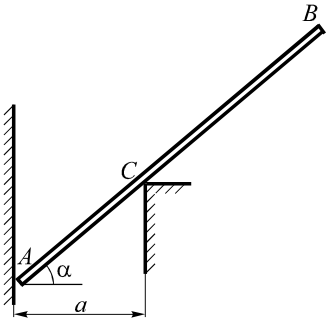
1. What value of force F_1 the reaction of weightless rod 1 will be equal to zero if $F_2 = 20$ N.



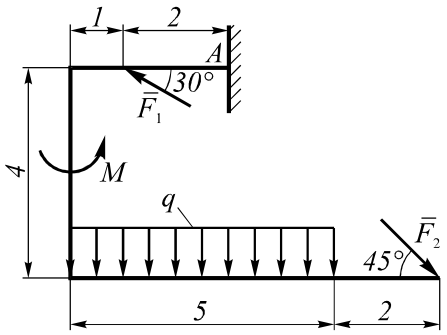
2. The load 1 is in the equilibrium by the inclined surface and two threads *AB* and *CDE*. The load 2 gravity force $G_2 = 20$ N, the surface reaction R = 10 N. The angle $\alpha = 30°$. Define the tension force of thread AB.



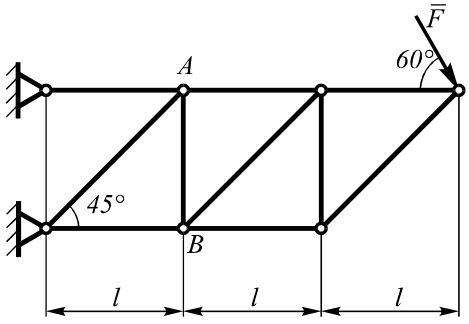
3. Disk with weight *P* and radius *R* is on the rough surface and touches the rough vertical wall. What moment *M* the pair of forces applied to the disk it will be in equilibrium if the coefficients of disk friction along the surface and wall are *f*.



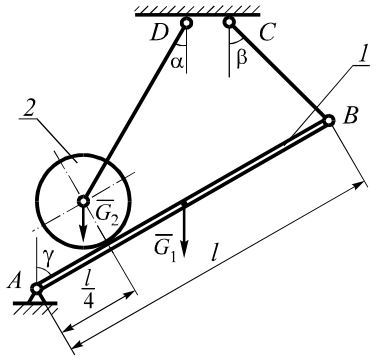
4. Rod *AB* with length *l* leans against the smooth vertical surface in point *A*, and in point *C* – against the ledge. Ignoring the friction define the distance *a* in equilibrium if the rod forms angle α with the horizon.



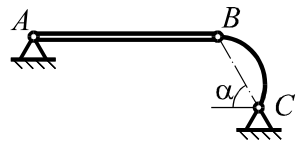
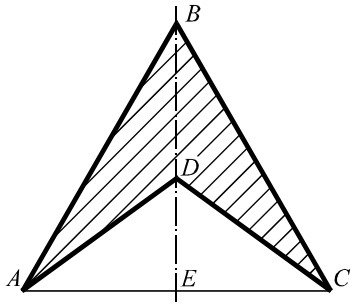
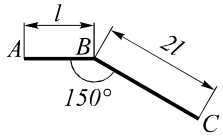
5. *Given:* $F_1 = 30$ kN; $F_2 = 20$ kN; $q = 4$ kN/m; $M = 50$ kN m.
Find the end restrain moment.



6. Define the internal force appearing in rod AB of the depicted plane framework which is under the influence of active force *F*.



7. In the depicted scheme homogeneous bodies 1 and 2 are connected to the ceiling by the weightless rods. Find the reaction of rod *BC* if G_1, G_2, α, β, γ are known.

	8. Homogeneous beam AB with weight 200 N is held in the horizontal position by weightless curvilinear rod BC. Define the constraint at point *A* if $\alpha = 60°$.
	9. From equilateral triangle *ABC* with side *a* isosceles triangle *ACD* is cut out as it is shown in the picture. Define at what distance *ED* point *D* is the gravity centre of the given figure.
	10. Define the distance from point B to the gravity centre of the depicted piece of wire of the constant cross-section. Size *l* is given.

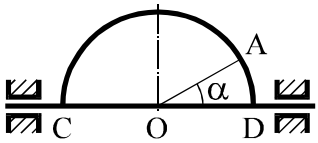
Kinematics

11. Equalization for the motion of particle in coordinates: $x = e^t + e^{-t}; y = 2t$. Fine the curvature radius of its trajectory.

12. From points A and B placed on one vertical line (point A is higher) at distance l =100 m between each other two balls are simultaneously thrown with the same speed 10m/sec: from point A – vertically down, from point B – vertically up. When do the balls meet? Free fall acceleration g = 9,8 m/sec^2.

13. The particle is moving along the branch x >0 of parabola $y = 4x^2$. Define the coordinates points when the value of speed is twice higher than its projection of axis x.

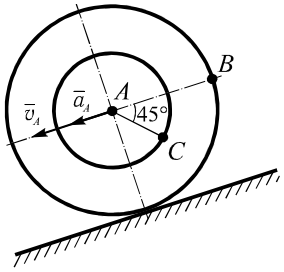
14. The point on the rim of the rotating shaft with the diameter of 20 cm is circumscribing a circle according to $s = 10\pi t^2$ cm law. Define the total acceleration of the point at the moment equal to the end of the first circle.



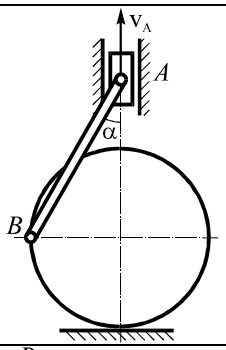
15. The half-disk is rotating around diameter CD**.** Radius OA = 10 cm forms angle 30° with this diameter. At some moment the normal acceleration of particle A is $a_A^n = 40\pi^2$ cm/ sec^2. Define the angular velocity of the body.

15. The point on the rim of the disk with diameter 10 cm is having the variable speed which can be described as $v = 10t^2$ cm/sec. What is the dependence of this speed on the angle of rotation of the disk?

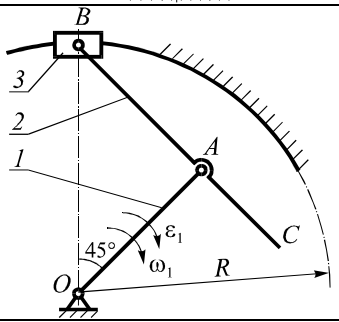
16. The particle is moving along the circle with radius r = 200 m with tangent acceleration 2 m/sec^2. Define the angle between the vectors of velocity and full acceleration of the particle in 5 sec after the start of its movement.



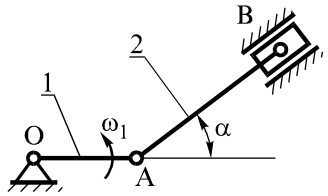
17. The disk is rolling without slipping so that at the moment v_A = 20 cm/sec, a_A = 5 cm/sec^2. Radii are AB = 10 cm, AC = 5 cm. Define the acceleration of particle C.



18. What point, A or B, speed is higher in the depicted position of the mechanism when angle $\alpha = 30°$, and how many times? The rolling is without slippering.



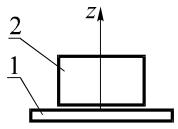
19. Define the acceleration of point C in the depicted position of the mechanism if at the moment $\omega_1 = 1\frac{\text{рад}}{\text{с}}$; $\varepsilon_1 = 4\frac{\text{рад}}{\text{с}^2}$; Given parameters: R = 50 см , $OA = AB$; BC = 60 см;



20. In plane mechanism the lengths of links 1 and 2 are l_1 and l_2 respectively. Crankshaft OA is rotating with constant angular velocity ω_1. Define the angular acceleration of link 2. Angle α is given.

Dynamics

21. The load with mass 200 kg is uniformly accelerated moving up the vertical with the help of the rope. Define the rope tension force if during the first 4 sec the load was lifted 8 m up.

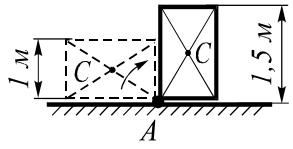


22. Platform 1 is moving along the vertical according to $z = b \sin^2 t$ law. On the platform cube 2 with mass m is placed. Define value и when the cube starts jumping over the platform.

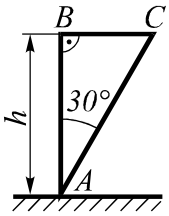
23. On the vertically fasten screw the screw pitch of which is h, the screw nut with mass m is put on. It has the inertia moment relative to the vertical axis I_z. The nut was set free from quiescent state. Ignoring friction define the velocity of its centre of masses just after it is down at $5h$ height.

24. The dynamic equalization of particle motion is $\ddot{x} + b\dot{x} + 100x = 0$. Define the maximal value of the resistance coefficient of elastic medium b when the damped vibrations are possible.

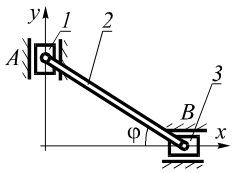
25. The material point with mass m is thrown vertically up with the initial speed v_0. Define at what height its potential energy is 2/3 of the kinetic energy.



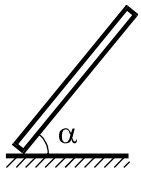
26. The box with the parameters shown in the picture by edge A rotation is placed from the horizontal position into the vertical position. Define the work necessary for lifting the bow if its mass is 80 kg, and the gravity centre is in the cross point of the diagonals.



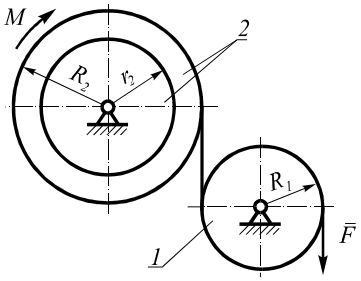
27. The homogeneous plate in the shape of the right-angled triangle with cathetus h and vertex angle 30° is put by its point A on the smooth horizontal surface in such a way that cathetus AB is parallel to the surface. Define the distance x for the move of point A of the triangle when falling down under its own weight when its hypotenuse AC is in the horizontal position.



28. Sliders 1 and 3 with masses $m_1 = m_3 = 2$ kg are moving in the rectilinear guides. They are connected by coupler link 2 with mass $m_2 = 4$ kg and length $l = 0{,}8$ m. Angle φ is changing according to $\varphi = \pi t$ law. Define the sum of all forces acting on the mechanism at moment $t = 0{,}25$ sec.



29. The solid homogeneous rod with length l and angle α with the horizon is freely falling down without rotation. It nonelastically bumps against the smooth horizontal surface with speed v_0. Define the rod angular velocity and the linear speed of its centre of mass at the first moment after the impact.



30. Given: $m_1 = m$; $m_2 = 2m$; M; F_c; $R_2 = 2r$; $r_2 = r$; $R_1 = r$; $i_{2x} = r\sqrt{2}$.
Define ε_2.