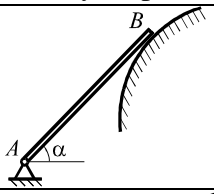
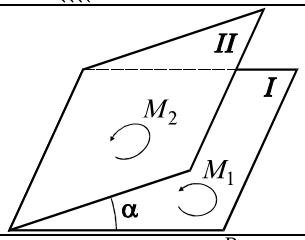
Statics

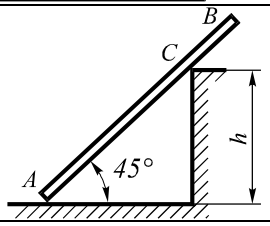
1. Train travels downhill. It has mass m = 700 tonnes. Train experiencing resistance force F = 70 kN. At what train's velocity slope will be a constant?



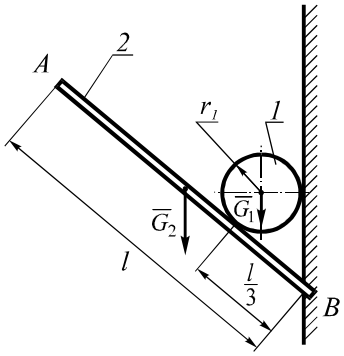
2. A homogeneous rod ***AB*** has 1.5 kN weight. The end ***B*** of the rod leans on the smooth surface. Determine the reaction of the hinge ***A*** if $\alpha = 60$ °.



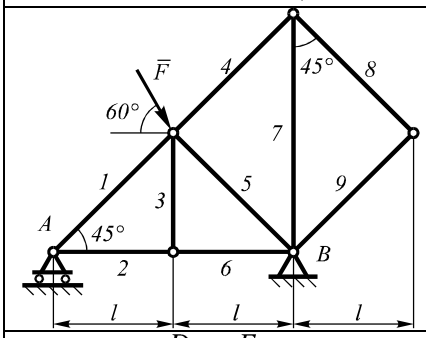
3. Forces couple with the moments M_1 = 7 Nm and M_2 = 8 Nm is applied to the solid. They are located in intersecting planes I and II. The resultant couple moment is 13 Nm. Find the angle α between the planes.



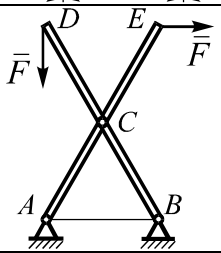
4. A uniform heavy rod AB has $2h$ length. It is located in the vertical plane. It lean it's A-end on the rough floor and it's intermediate point C – to the the ledge with h height. Point A has friction coefficient f = 0,6. Will the rod be in equilibrium? Friction at the point C is neglected.



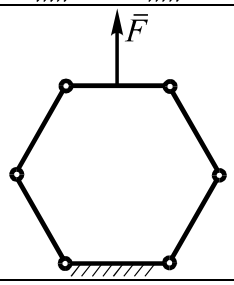
5. $\boldsymbol{G_1}$, $\boldsymbol{G_2}$, $\boldsymbol{l}$, $\boldsymbol{r}$ are known. Determine the moment (couple) of fixed support.



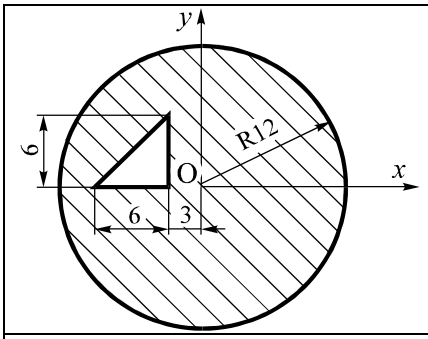
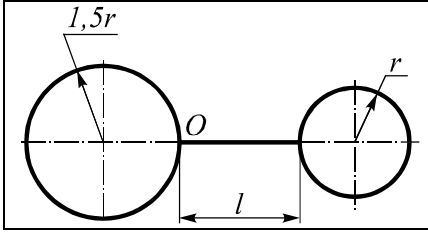
6. Force ***F*** is known. Determine the force which appears in the 5th rod of the truss



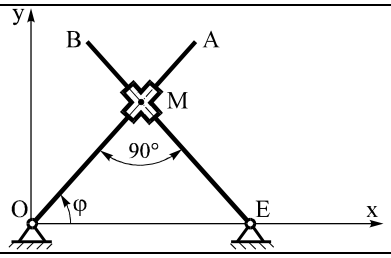
7. The X-shaped fixed and located in the same plane. It is loaded by two equal forces in modulus F. The rods AE and BD are connected with hinge. $AC = CE = BC = CD = AB$. Find hinge A reaction neglecting the rods weights.



8. Six identical homogeneous rods each other have P weight. They connected by the hinges at their ends and form a regular hexagon. The hexagon is located vertical position. The lower rod is fixed in a horizontal position. Find a vertical upward force applied to the middle of the upper horizontal rod. The system should be in equilibrium?

	9. Find the coordinates of the additional cutting center circle with r = 4 cm. The gravity center of the cross section should be at the point O
	10. Object consists of a rod with constant cross-section. Find the distance from point O to the gravity center of the object.

Kinematics



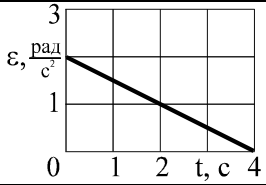
11. Point *M* belongs to the mechanism shown on the figure. Find the point *M* trajectory equation. *OE* = 20 cm.

12. Airplane flying at a 720 km / h speed. From some moment the plane moves with a constant tangential acceleration during 10 sec. During the last second it passes *s* = 295 m. Find a finite speed of the plane.

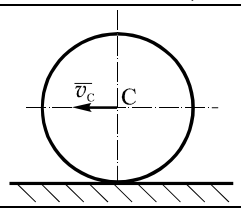
13. Point moves along a curved path. It has tangential acceleration of 2 m/s^2 from rest. Find the angle between the velocity vector and full acceleration vector at time point *t* = 2 sec, when the trajectory curvature radius is ρ = 4 m

14. The point is 4 cm far from the rotating axis of a rigid body. The linear velocity of this point $v = 16t^2$ cm/sec. Find the tangential acceleration of the point when φ=8 rad. φ is a rotation angle of the body.

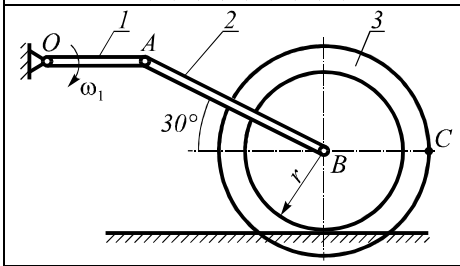
15. The angular velocity of the body rotation is $\omega = 2t$ rad/sec. Point ***A*** belongs to the body and the distance between this point and the rotation axis of the body is $r = 0{,}1$ m. Find linear acceleration of the point ***A*** at the time equal to 3 sec.



16. The angular acceleration of the body varies as shown by the graph. Find the ***A*** point speed of the body at a distance r = 0,3 m from the axis of rotation at a time equal to 3 sec. $\omega_0 = 10\dfrac{\text{rad}}{\text{sec}}$

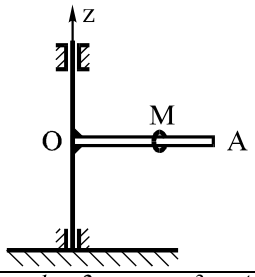


17. The wheel of radius R = 10cm begins to roll without slipping and $\boldsymbol{v_{C0}}$ = 0,5 m / sec. The wheel has made 50 turns and then had stopped. Find the distance traveled by point C, considering the rotation of the wheel uniformly accelerated.

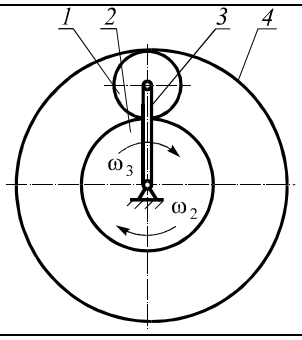


18. Given: $\omega_1 = 2\dfrac{\text{рад}}{\text{с}}$; $OA = 12$ см; $AB = 20$ см; $BC = 6$ см; $r = 4$ см.

Find: v_C.



19. The rod *OA* rotates about the axis *z* , $\varphi = \varphi_0 e^{\alpha t}$ (φ_0 and α are constants). A ring ***M*** moves along this rod. Find the law of ring relative movement *s(t)*, if its Koreolis acceleration is constant and is equal to a_k . $s_0 = 0$.

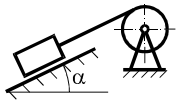


20. Given: $\omega_2; \omega_3; r_1 = r; r_2 = 2r.$

Find: ω_4.

Dynamics

21. The material point of mass m is hanged to the spring. The spring deformation during static influence of the gravity is equal to 50 mm. Find the frequency of the material point.

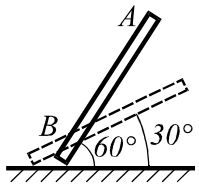


22. The load moves up on the smooth plane inclined to the horizon at an angle α. The drum of radius $\boldsymbol{r}$ rotates with a constant angular acceleration $\boldsymbol{\varepsilon}$. Find the reaction of the surface, if the cable tension force is equal to $\boldsymbol{T}$.

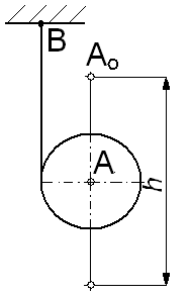
23. The glider of mass $\boldsymbol{m}$ moves horizontally with an initial velocity v_0. The force of air resistance in glider free flight is $F = kv$, where k is constant. Find the law of glider velocity.

24. The material point moves horizontally with a constant acceleration $\boldsymbol{a}$. The relative velocity of the mass changing $\boldsymbol{u}$ = const. Find the law of material point mass. The initial mass is equal to $\boldsymbol{m_0}$.

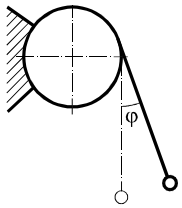
25. The car is at rest on a horizontal surface. It has mass $\boldsymbol{m}_1$(without wheels). Consider wheels as homogeneous disks with a total mass $\boldsymbol{m}_2$. The constant force $\boldsymbol{F}$ is applied to the car and its direction is parallel to the rails. The wheels are rolling without slipping. Find the acceleration of the car body. Resistance forces are ignored.



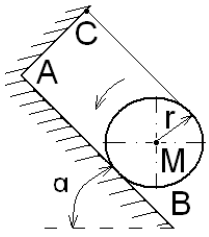
26. Homogeneous rod of length $\boldsymbol{l}$, falls to the smooth horizontal surface from the state of rest by gravity. At the initial moment the angle $\varphi_0 = 60°$. Find the rod end $\boldsymbol{B}$ movement in the moment when $\varphi = 30°$.



27. A homogeneous cylinder of mass $\boldsymbol{m}$ is wrapped around with a thin thread. The end of the thread $\boldsymbol{B}$ is motionless. The cylinder falls without initial velocity, reelling off the thread. Determine the velocity of cylinder axis after its falling to the height $\boldsymbol{h}$.



28. The pendulum consists of a material point of mass $\boldsymbol{m}$, which is suspended by a thread wrapped on a fixed cylinder of radius $\boldsymbol{r}$. Length of the thread hanging in the equilibrium position is equal to $\boldsymbol{l}$. Find the law of potential energy in dependence on the thread rotation angle $\boldsymbol{\varphi}$.



29. A flexible thread is wrapped around a homogeneous cylinder of mass $\boldsymbol{m}$ and radius $\boldsymbol{r}$. Cylinder starts its movement without initial velocity by force of gravity and overcomes the friction with a surface. The coefficient of friction is $\boldsymbol{f}$. Determine the tension force $\boldsymbol{T}$ of the thread. The angle α is known.

30. Steeply falling ball hits the smooth surface. The surface has an angle with the horizon equal to α. Immediately after hitting the ball velocity vector is horizontal. Find the recovery coefficient of the impact.