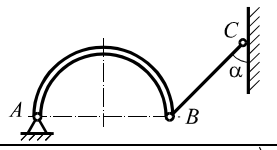
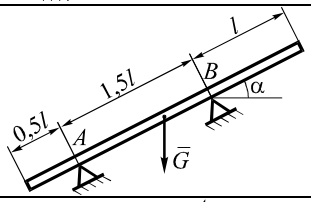
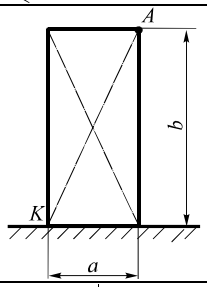
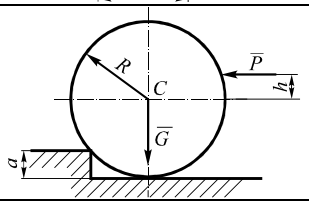
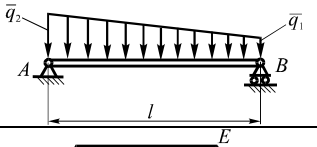
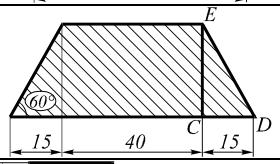
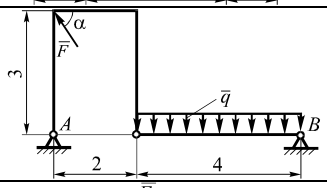
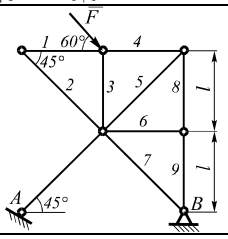
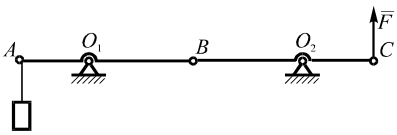
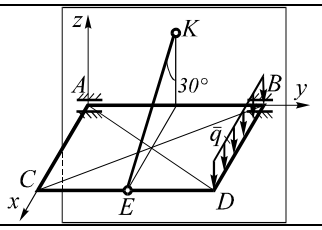
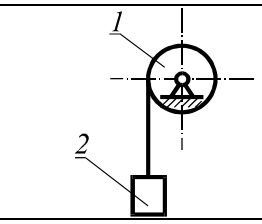
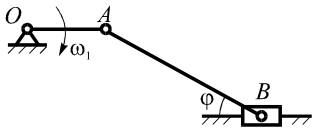
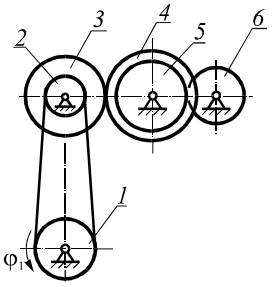
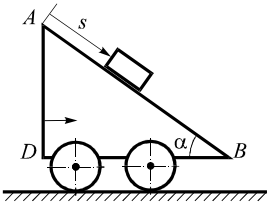
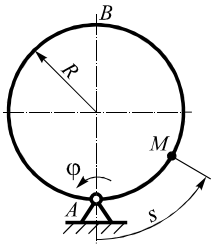
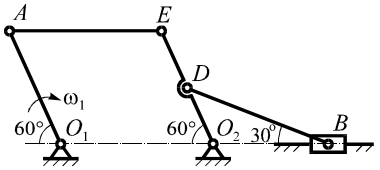
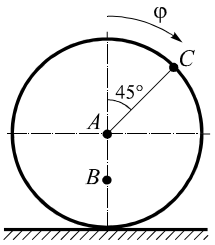
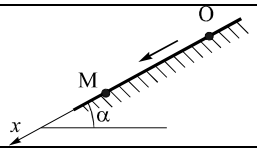
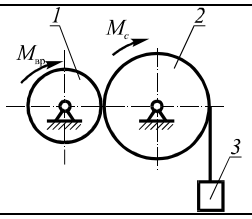
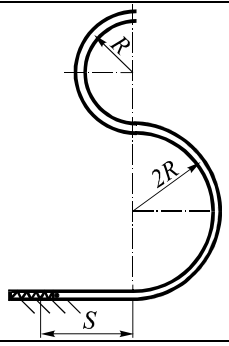
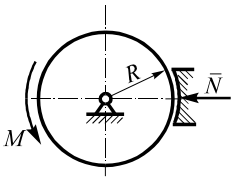
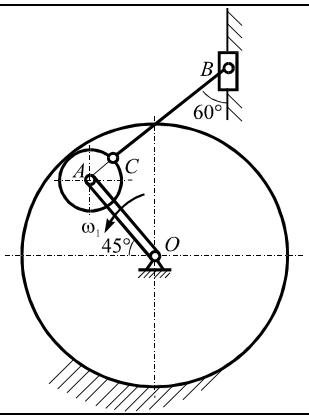
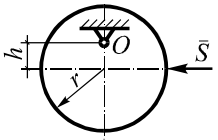
Brain-ring 2016

	Statics	
1	The end A of curved rod AB of $10\sqrt{2}$ N weight is fixed by the hinge. The second end of rod is in the equilibrium due to the cable BC. Determine the sum of the hinge A and cable BC reaction forces if $\alpha = 45°$.	
2	A beam of 50 N weight rests on the smooth ledge A and on the rough surface B. Find the maximal value of angle α for the equilibrium of the beam if the friction coefficient between the beam and the ledge B is equal to 0,3.	
3	Rectangular plate of mass $m = 5$ kg is located in the vertical plane on the rough surface. Plate edges $a = 0,8$ m и $b = 2$ m. Define the minimal absolute value of a force applied to point A able to overturn the plate around point K. Plane moves without sliding.	
4	Determine the size h, if the horizontal force $P = 100$ N applied to the cylinder of radius $R = 40$ cm and weight $G = 240$ N can overturn the cylinder over the stair of height $a = 10$ cm.	
5	Find the ratio q_1/q_2 of the distributed forces applied to the weightless horizontal beam if $R_A = 1,5R_B$.	
6	Determine of the horizontal displacement of the equilateral trapezoid center of mass after cutting the triangle CDE. Dimensions are shown in the figure.	
7	Find the value of angle α for case of equilibrium of the shown construction if $F = 16$ N, $q = 6$ N/m.	
8	Define the reaction force in rod 5 of the plain truss if $F = 140$ кН.	
9	Two weightless rods are fixed in the hinges O_1 and O_2 and are connected by the hinge B. A load of mass $m = 5$ kg is applied to the end A. Find the necessary value of force F, for the equilibrium of the construction if $AB = 1$ m; $AO_1 = 0,2$ m; $BC = 0,75$ m; $BO_2 = 0,5$ m.	
10	The rectangular plate of 45 kN weight is in the equilibrium. Determine the reaction force in the revolute joint B if the plate is under the evenly distributed force with an intensity $q = 10$ kN/m. $AC = BD = 0,8$ m.	

	Kinematics	
11	The material point moves from the position of rest along a circle of radius 8 m. Normal-acceleration of the point depends on the time by the law $a_n = 2t^4$. Determine full acceleration of the point at time equal to 1 second after the beginning of points' motion.	
12	Point moves so that the covered distance s is proportional to the difference of the initial velocity v_0 and the velocity v at the considered moment of time. The proportionality coefficient is equal to k. Define the dependence $a(v)$ of the points' acceleration on its velocity.	
13	The disk rotates relative to the fixed axis and its rotational angle $\varphi = 1{,}5t^2\text{-}1$, rad. Find the distance between the point M and the rotational axis if the acceleration of the point is equal to 10 cm/s^2 at time $t_1 = 1$ s.	
14	Connected to the cable load 2 rises with acceleration $a_2 = 0{,}2t$ (m/s^2) from its rest. Disc 1 has a diameter of 80 cm. At what moment of time (counting from the start of loads' motion) angle between velocity and acceleration of the disc points will be 45^0?	
15	Find the value of angle φ if $v_B = 52$ cm/s, $\omega_1 = 2$ rad/s, $OA = 15$ cm.	
16	In the shown mechanism wheel 1 rotates by the law $\varphi_1 = 9t$, rad. Define the radius of wheel 6 if its rotational velocity is equal to 6 rad/s, radii of wheels are: $R_1 = 12$ cm, $R_2 = 8$ cm, $R_3 = 16$ cm, $R_4 = 18$ cm, $R_5 = 14$ cm.	
17	At time $t = 2$ s determine the ratio $\frac{y}{x}$ of absolute vertical (y) and horizontal (x) coordinates of load P, moving along the edge AB by the law $s{=}0{,}2t^2$(m). The position of body ADB changes by the $t\sqrt{3}$ (m); $AD = 1{,}2$ m; $\alpha = 30°$. At the initial moment of time load P was at point A of the prism.	
18	Find the value of the Coriolis acceleration of point M moving along the rim of a rotating disk, if $\varphi(t) = 8\sin\frac{\pi t}{8}$ rad; $s(t) = 2{,}5\pi t^2$ cm; $R = 5$ cm; time $t = 2$ s.	
19	For the shown position of the mechanism it is necessary to determine the velocity of point B, if $\omega_1 = 4$ rad/s, $O_1A = O_2E = 30$ cm, $O_2E = 2ED$.	
20	Find the acceleration of point B of the wheel rolling without slipping if $\varphi = t^3$рад; time $t = 1$ s; $AB = 12$ cm; $AC = 25$ cm.	

	Dynamics	
21	Given*:* m = 1 кг; $\alpha = 30°$; resistance force $F_{res} = bt - k$; $v_0 = 0$; $x_0 = 0$. Define the time from the start of point motion to its stopping if $b = 0{,}4$; $k = 0{,}6$.	
22	The motion of a material point is described by the differential equation $0{,}5\ddot{x}+20\dot{x}+128x=0$. Determine the period of oscillations of the point.	
23	Two gears of radiuses R_1 = 10 cm and R_2 = 20 cm are in toothing. The gear 2 is under the resistance torque M_r= 10 N·m. The load 3 of mass m_3 = 10 кг is hanged to the gear 2. Determine the power of the rotational torque M_{rot}, applied to the gear 1 if load 3 has the constant velocity value v_3 = 10 m/s.	
24	The material point of mass m = 5 kg is fixed on the end of weightless rod of length l = 1 m. The second end of the rod is fixed by a hinge so that the rod can rotate around the hinge in the vertical plane with a constant angular velocity. Find the value of this angular velocity if the rod can withstand a maximum stretching force $F_{\max}^{\text{streching}} = 100$ N.	
25	A ball of mass 250 gram starts to move inside the tube in the vertical plane without initial velocity. At the initial moment of time the shown spring of rigidity c =10 N/cm was compressed by 5 cm. Determine the maximal height of the ball rising if S = 0,2 m, friction coefficient f = 0,3. The friction if neglected on the curved parts of the tube.	
26	Vertical lift of the cargo of mass m = 1000 kg is ensured by the rope wound onto a pulley of radius R = 0,3 m. The pulley rotates with the angular acceleration $\varepsilon = 2t$ rad/s^2. Define the law of the change of the rope tension force.	
27	Homogeneous disk of mass 250 kg and radius $R = 0{,}26$ *м* rotates around the motionless axis under the rotating torque M = 180 N·m. The rotation of the disk is being decelerated by the brake shoe. The brake shoe act the disk with the force N = 800 N. Find the friction coefficient between the disk and the brake shoe if the rotational acceleration of the disk is 15 rad/s^2.	
28	Define the kinetic energy of the slide B, if it is given that: m_B = 10 kg, ω_1 = 2 rad/s, OA = 0,5 m, AC = 0,3 m, CB = 1,2 m, $AC \perp AO$.	
29	The disk of radius r, can rotate around axis O. The shock impulse S hit the disk along its central line so that the shock impulse of the reaction force in point O is two times less than impulse S. Determine the distance h from the axis O to the center of the disk.	
30	Find the dependence of the angular velocity of wheel 2 on the displacement s of the load 1. The wheel rolls without slipping. Masses $m_2 = 2m_1 = 4m$*;* friction coefficient f = 0,25; wheel radii $R_2 = 2r_2$ = 0,4m; $\alpha = 45°$, $I_{2x} = m_2 r_2^2$.