1.104. A particle of mass m moves in the plane P under the action of the force $\boldsymbol{F}$ of a constant modulus, which rotates in this plane with a constant angular velocity ω. At time $t = 0$, the particle was at rest. Find the:

(a) modulus of its velocity as a function of time;

(b) path travelled by the particle between two successive stops, and the mean velocity on this path.

1.105. A small washer is placed on an inclined plane that makes an angle α with the horizontal (Fig. 1.18), with an initial velocity v_0. Find the dependence of velocity of the washer on angle φ, if the friction coefficient $k = \tan\alpha$ and at the initial moment $\varphi_0 = \pi/2$.

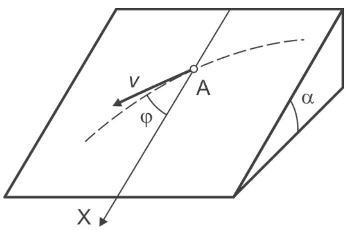

Fig. 1.18

1.106. A chain of length l was placed on a smooth spherical surface of radius R, such that its one end is secured on top of the sphere. With what acceleration a will each element of the chain move, if the upper end is released? Chain length $l < \pi R/2$.

1.107. A small body was placed on top of a smooth sphere of radius R. Then the sphere is imparted a constant acceleration $\boldsymbol{a}_0$ in the horizontal direction, and the body began to slide down. Find the velocity of the body relative to the sphere at the moment of break-off. Compare with the solution of 1.95.

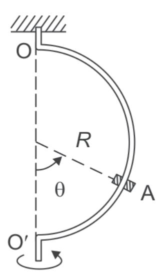

Fig. 1.19

1.108. A sleeve A can freely slide along a rod, bent in the form of a semi-circle of radius R (Fig. 1.19). The system is led into rotation with constant angular velocity v. To what height (relative to the initial level) will the disc rise after breaking off the body M? The friction is assumed to be absent.

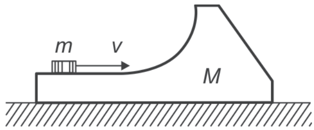

Fig. 1.37

1.196. A small disc of mass m slides down a smooth hill of height h without initial velocity and gets onto a plank of mass M lying on the horizontal plane at the base of the hill (Fig. 1.38). Due to friction between the disc and plank the disc slows down and beginning with a certain moment, moves as one piece with the plank. Find the total work performed by the friction forces in this process.

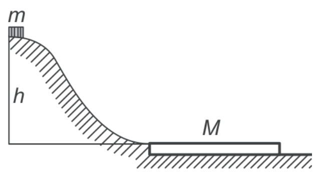

Fig. 1.38

1.197. A plank AB of length l = 100 cm lies on a smooth horizontal plane, a small disk lies on its end A. The mass of plank is $\eta = 10$ times greater than the mass of the disk, friction coefficient between both of them is k = 0.15. What initial velocity needs to be imparted to the disk in direction from A to B, so that it can slide off the plank?

1.198. Find the increment of the kinetic energy of the system of two spheres of masses m_1 and m_2, during their perfect inelastic collision. The velocities of the spheres before collision were $\mathbf{v}_1$ and $\mathbf{v}_2$.

1.199. A particle A of mass m flying near another stationary particle B, deviated at an angle α. Momentum of the particle A before the interaction was equal to p_0 and after the interaction it was p. Find the mass of the particle B, if this is a closed system.

1.200. At a certain point two identical particles, forming a close system, are at a distance l_0 from each other and have velocity v, whose direction form an angle α with the connecting line (Fig. 1.39). Mass of each particle

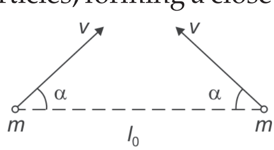

Fig. 1.39

(b) a uniform solid cone relative to its symmetry axis, if the mass of the cone is equal to m and radius of its base to R.

1.281. Find the moment of inertia of a thin wire ring of radius a and mass m relative to the axis, coinciding with its diameter.

1.282. Demonstrate that in the case of a thin plate of arbitrary shape there is the following relationship between the moments of inertia: $I_1 + I_2 = I_3$, where sub-indices 1, 2, and 3 are three mutually perpendicular axes passing through one point, with axes 1 and 2 lying in the plane of the plate. Using this relationship, find the moment of inertia of a thin uniform round disc of radius R and mass m relative to the axis coinciding with one of its diameters.

1.283. The moment of inertia of the body relative to the mutually parallel axes 1 and 2 is equal to $I_1 = 1.00\ \text{g}\cdot\text{m}^2$ and $I_2 = 3.0\ \text{g}\cdot\text{m}^3$ respectively. Axes 1 and 2 are situated at distances $x_1 = 100$ mm and $x_2 = 300$ mm from the center of mass C of the body. Find the moment of inertia of this body relative to the axis, passing through point C and parallel to the axes 1 and 2.

1.284. A uniform disc of radius R has a round cut out (Fig. 1.53). The mass of the remaining (shaded) portion of the disc is equal to m. Find the moment of inertia of such a disc relative to the axis perpendicular to the plane of the disc and passing through:

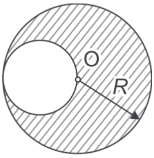

Fig. 1.53

(a) the point O;

(b) its center of mass.

1.285. Using the formula for the moment of inertia of a uniform sphere, find the moment of inertia of a thin spherical layer of mass m and radius R relative to the axis passing through its center.

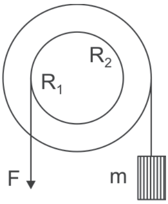

Fig. 1.54

1.286. Two threads are wounded on a step pulley in opposite directions (Fig. 1.54).

tube and flask equals $r = 25$ cm and the wall thickness is equal to $\Delta r = 1.0$ mm?

1.349. A horizontally oriented copper rod of length $l = 1.0$ m is rotated about a vertical axis passing through its center. What is the number of rps at which this rod ruptures?

1.350. A ring of radius $r = 25$ cm made of lead wire is rotated about a stationary vertical axis passing through its centre and perpendicular to the plane of the ring. What is the number of rps n at which the given ring can rupture?

1.351. A steel wire of diameter $d = 1.0$ mm is stretched horizontally between two clamps located at the distance $l = 2.0$ m from each other. A weight of mass $m = 0.25$ kg is suspended from the midpoint O of the wire. What will the resulting descent of the point O?

1.352. A uniform elastic plank moves over a smooth horizontal plane due to a constant force F_0 distributed uniformly over the end face. The surface area of the end face is equal to S, and Young's modulus of the material is E. Find the compressive strain of the plank in the direction of the acting force.

1.353. A thin uniform copper rod of length l and mass m rotates uniformly with an angular velocity ω in a horizontal plane about a vertical axis passing through one of its ends. Determine the tension in the rod as a function of the distance r from the rotation axis as well as the elongation of the rod.

1.354. A solid copper cylinder of length $l = 65$ cm is placed on a horizontal surface and subjected to a vertical compressive force $F = 1000$ N directed downward and distributed uniformly over the end face. What will be the resulting change of the volume of the cylinder in cubic millimeters?

1.355. A copper rod of length l is suspended from the ceiling by one of its ends. Find the:

(a) elongation of the rod due to its own weight;

(b) relative increment of its volume $\Delta V/V$.

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