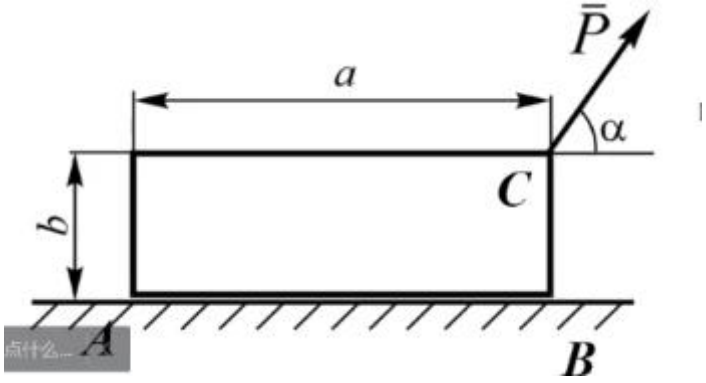
第三届国际大学生工程力学竞赛亚洲赛区试题

S-1

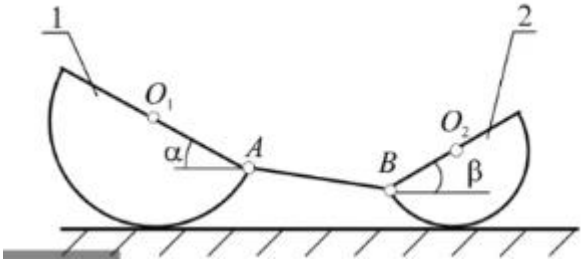
A uniform rectangle with the base *a*, height b and the weight *Q* lies on a rough horizontal plane. The coefficient of friction is *f*.

What conditions should the force P satisfy to ensure the rectangle equilibrium at any value of the angle α(0 ≤α≤π/2)? The force P is located in the rectangle plane.



S-2

Two homogeneous half-discs 1 and 2 have radii R_1 and R_2 and weights P_1 and P_2 correspondingly. The half-discs are connected by a homogeneous rod AB of weight Q, at the point A and at the point B there are hinges. The system is located in a vertical plane, the half-discs rest on a horizontal smooth floor. Define angles α and β for the case of the system equilibrium.



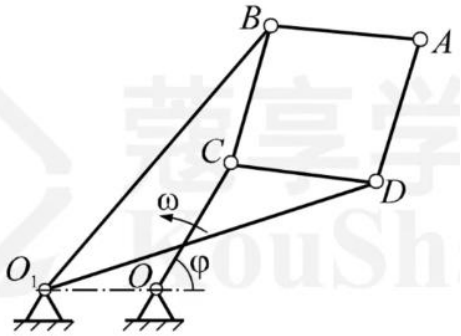
K-1

The contour ABCD consists of rods of the same length, that are connected to each other by hinges. In the points B, C and D it is connected to the cranks O_1B,O_1D,OC by hinges. The crank OC evenly rotates around the axis O with a angular velocity ω. There are known the following parameters:

$$OO_1=OC=r,\ O_1B=O_1D=l,\ AB=BC=CD=DA=a.$$

The above mentioned dimensions of the mechanism links allow the crank OC to rotate at an angle $\varphi \le \pm\pi/2$.

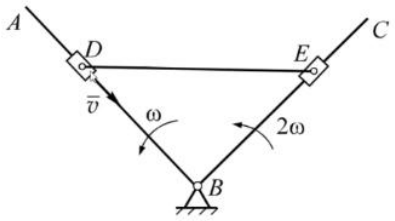
Find the velocity and the acceleration of the point A.



K-2

The rods AB and BC evenly rotate around the motionless hinge B with angle velocities ω and 2ω correspondingly. The rod DE of length a connects the sliders moving along AB and BC. The slider D moves with a constant velocity $v=\omega a$ relatively to AB.

Determine the velocity and the acceleration of the slider E relatively to the rod BC, and the angular velocity of the rod DE at the moment when the triangle BDE is equilateral.

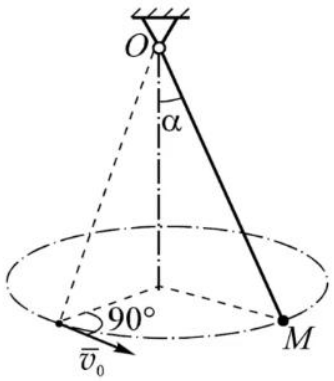


D-1

A **heavy material point M moves along a horizontal rough surface. There is a thread linked to the point O, the free end of the thread is fixed at the point O. When the point M moves the thread forms a tapered surface with apex angle 2α.**

It is known that the friction coefficient is equal to *f*, *OM=l.*

Find the initial velocity which the point should be given to make one full turn. What condition the initial velocity of the point should satisfy to ensure no detach of the point from the plane?



D-2

An elliptical pendulum consists of a slider with a mass m, which can slide along a smooth horizontal plane and a uniform rod AB of mass *m* and length *l*, connected to the slider by the hinge. At a certain moment of time, at which the system is in equilibrium, the slider is hit with an impulse *S*.

Define the maximal deflection angle of the rod.

