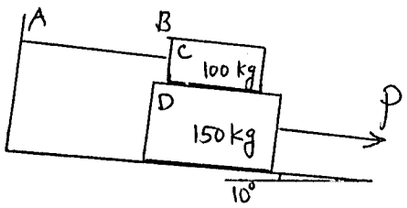
1. The coefficients of friction are $\mu_s = 0.30$ and $\mu_k = 0.25$ between all surfaces of contact. Determine the smallest force P required to start block D moving if (a) block C is restrained by cable AB as shown. (b) cable AB is removed.



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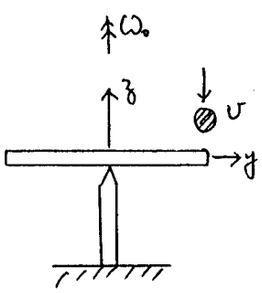
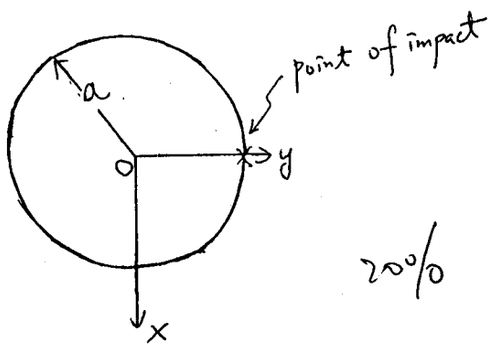
2. A uniform circular disc of mass M and radius a is mounted so that it can turn freely in any direction about its center, which is fixed. Initially the disc is in a horizontal plane and is spinning with angular velocity ω_0 about an axis perpendicular to the disc. A particle of mass m falls vertically with speed v and hits the edge of the disc. The disc is smooth and the impace is elastic. xyz are body fixed axes with the y axis passing through the point of impact.

a) Determine $\omega_x, \omega_y, \omega_z$ of the disc immediately after impact.

b) Show that after the impact ω_x and ω_y are periodic functions of time, and determine their period.





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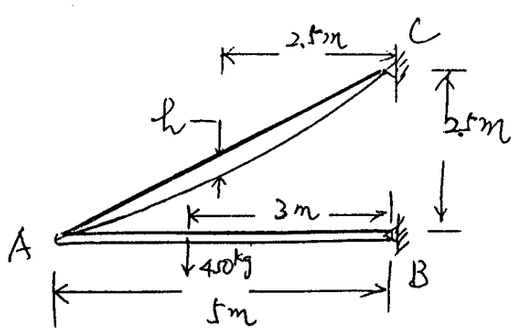
3. The total mass of cable AC is 25 kg. Assuming the mass of the cable is distributed uniformly along the horizontal, determine the sag h and the slope of the cable at A and C.



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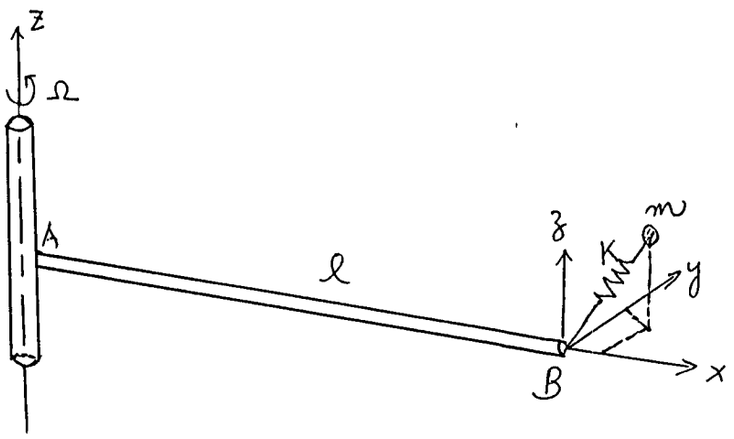
4. A particle of mass m is attached to the end of a rigid rod AB by means of a linear spring having a spring constant k. The rod AB is rotating with angular velocity Ω about a space-fixed Z-axis. Let the rotating xyz-coordinate system be attached to the end of the rod as shown.
Either by drawing a free body diagram and applying Newton's laws, or by using Lagrange's equations, obtain the three equations of motion of the mass m in terms of the xy -system. Write these equations in matrix form. Identify the matrix arising from Coriolis forces.



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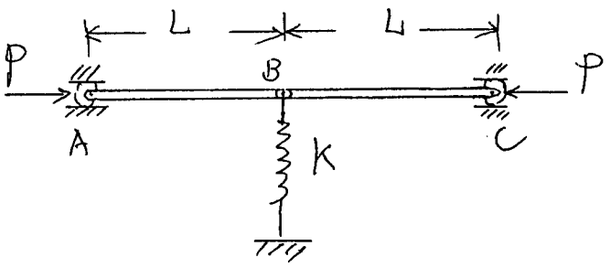
5. Two bars AB and BC of negligible weight are attached to a single spring of constant k which is undeformed when the bars are horizontal. Determine the range of values of the magnitude P of the two equal and opposite forces P and -p for which the equilibrium of the system is stable in the position shown.



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