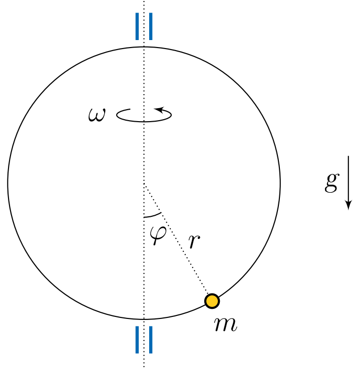
Hint 2

1. You can continue to send the solution to the main problem.
2. At any time before the final deadline, you can switch to *alternative task*. If you do this, write *a*t the very beginning of the solutionI'm moving on to an alternative task!. In this case, you get an additional coefficient of 0.7, which is multiplied by the old coefficient, and the solutions to the main problem are not checked from this point on. Be careful!
3. The task consists of several items. The penalty multiplier earned by **before** is applied to all points. In the future, each item is evaluated as a separate task. If you send a solution without any item, this item's solution is considered as Incorrect. For more information about scoring points for composite tasks, see the rules of the Cup.

Alternative problem

1. *(1 pts)* A small load of mass m is attached to a bar with a length of l located in the field of gravity. The load is given some initial speed v_0. Draw phase diagrams of load oscillations, i.e. dependence of $\dot{\varphi}$ on φ for the following values of velocity v_0: a) $v_0 = \sqrt{gl}$, b) $v_0 = \sqrt{3gl}$, c) $v_0 = \sqrt{8gl}$.
2. A smooth ring of radius R is located vertically and rotates around to the vertical diameter with a constant angular velocity ω. A small bead of mass m can move along the ring.
   (a) *(2 pts)* Define the equilibrium positions of the bead and examine them for stability at various angular velocities ω.
   (b) *(2 pts)* Find the frequency of small fluctuations of the load if $R = 10$ cm, $\omega = 5$ s^{-1}
   (c) *(2 pts)* In case $\omega^2 R > g$ find the value ω when the oscillation frequency of the load will be equal to $\omega/2$.



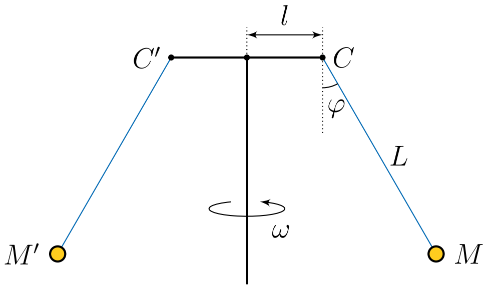
3. Many propulsion systems used in technology are constructed to create rotational motion. Moreover, an extremely important technical task is to maintain a constant angular velocity of rotational motion. In the figure the scheme of *Watt controller* is shown. One of its the tasks was the measurement of angular velocity. The regulator consists of a vertically rotating shaft with which two identical rods are connected using the joints C, C' and to

the free ends of the rods two identical massive bodies M are attached. When the shaft rotates, the rods deviate by a certain angle from the vertical axis.

(a) *(1 pts)* Find the angular velocity of rotation of ω at which the deviation angle is φ.

(b) *(1 pts)* Draw a graph of the dependence of ω on the deviation angle of φ

(c) *(For the first time in this our big top 0 points per task)* Analyze for which values of the angular velocity of rotation of the system the controller works optimally.



4. *(1 pts)* Build a mechanical analogy for the following electrical circuit diagram.