

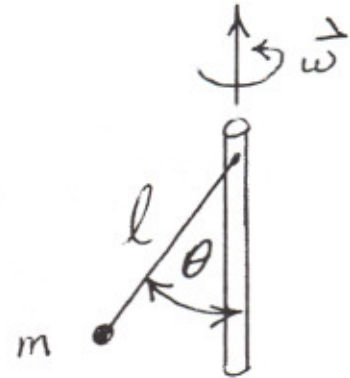
Classical Mechanics

Problems are worth 25 points each.

- Assuming circular orbits for two bodies about their center-of-mass, derive Kepler's Third Law of Planetary Motion, viz., that the square of the period is directly proportional to the cube of the average distance. Evaluate the constant of proportionality.
- If the Mississippi River is 1 kilometer wide and flowing due south at a speed of 5 km/hr at latitude 45° , how much higher is the water level at the right (west) bank than at the left (east) bank?

HINT: Because water is a fluid, the horizontal force of the Coriolis effect is balanced by the vertical force of gravity.

- A string of length l with a mass m is attached to a vertical rod rotating with constant angular velocity ω in the Earth's gravitational field. Using Lagrange's equations, find the angle θ which the string makes with the vertical rod for equilibrium conditions. See figure.



- Two equal masses are attached to the end of the spring, with spring constant k , which is on a horizontal frictionless table. Find the period and the relative coordinates of the normal mode of vibration, if the masses are pulled apart and then released.

