

Ph 106a

Homework Assignment No. 4 Due: Thursday, 1 November 2007

1. **Differential cross section.** A particle of mass m and total energy E moves in the potential

$$V(r) = \begin{cases} -C, & r < r_0, \\ 0, & r > r_0. \end{cases} \quad (1)$$

- a) Find the angle ϕ through which a particle with impact parameter s is scattered. (This problem can be solved by using only the appropriate conservation laws.)
- b) Find the differential cross section $d\sigma/d\Omega$.
2. **Foucault pendulum.** Almost every science museum has a Foucault pendulum. It consists of a heavy ball suspended by a long wire, which is free to swing in any direction. If the pendulum starts swinging in a vertical plane, the Coriolis force causes the plane of its swing to rotate about the vertical axis. Calculate the angular frequency Ω of this rotation, for a science museum at latitude θ . (You may use the approximation of small oscillations.)
3. **Torque-free precession.** Suppose that the earth is perfectly spherical, except for two mountains on opposite sides of the earth. One mountain is at 45° south latitude, 0° longitude, and the other is at 45° north latitude, 180° longitude. How far will the north pole wander in a century? (The earth has mass $6 \times 10^{24}kg$ and radius 6×10^6m . The mass of a mountain is $10^{12}kg$.)
4. **Spinning cube.** What is the moment of inertia of a uniform cube of mass m and side a about an axis along the cube diagonal? (Hint: find the inertia tensor.)