JOINT INSTITUTE
交大密西根学院

PHYSICS I (Summer 2017)

Problem Set 9

Due: 20 July 2017, 12.30 p.m.

Problem 1. Based on measurements of rotational energy levels of a HF molecule, its moment of inertia about the axis perpendicular to the line connecting both atoms, passing through the center of mass of the system, has been estimated at $1,37 \cdot 10^{-47}$ kg$\cdot$m^2. Find the distance between the H and the F atoms if their masses are $m_{\mathrm{H}} = 1,67 \cdot 10^{-27}$ kg, $m_{\mathrm{F}} = 3,17 \cdot 10^{-26}$ kg, respectively.

(*2 points*)

Problem 2. Justify the following statement that we mentioned in class when we were discussing the moment of inertia of a disk: *For a planar object, the moment of inertia about an axis perpendicular to the plane is the sum of the moments of inertia about two perpendicular axes through the same point in the plane of the object.*

It is known as *the perpendicular axis theorem.*

(*3 points*)

Problem 3. Find the moments of inertia of

(a) a hollow cylinder with inner radius R_1, outer radius R_2, and height H, about the axis of symmetry. The cylinder is not uniform and the bulk density of mass depends on the distance r from the axis of symmetry as αr with $\alpha > 0$;

(b) a triangle with the surface density of mass σ, base length a, and height h about the axis containing the base;

(c) the same triangle about the axis parallel to the base through the vertex,

(*3 $\times$ 3 points*)

Problem 4. What is the moment of inertia of the cylinder from Problem 3 (a) about the axis parallel to the axis of symmetry, and tangential to the outer side wall.

(*1 point*)