

PHYS 4330 Theoretical Mechanics

Homework # 9

Submission deadline: 26 March 2024 at 11:59 pm Eastern Time

Submission Instructions: Homework is submitted on Gradescope to Homework 9.

1. A system of three particles consists of masses M_i and coordinates (x_1, x_2, x_3) as follows:

$$M_1 = 2m, (b, 0, 0)$$

$$M_2 = 2m, (0, b, 2b)$$

$$M_3 = 2m, (0, 2b, b)$$

- a) Calculate all elements of the inertia tensor for the system.
- b) Find the principal moments of inertia and a set of ortho-normal principal axes.

[10 points]

2. Consider a thin disk composed of two homogenous halves connected along a diameter of the disk. One half has the density ρ and the other has density 2ρ .

- a) Find the position of the center-of-mass of the disk (make sure your coordinate choice is clear).
- b) Consider an axis which is perpendicular to the plane of the disk and goes through the geometric center of the disk. Calculate the moment of inertia of the disk with respect to this axis.
- c) Find the moment of inertia of the disk for an axis which is perpendicular to the plane of the disk and goes through the center of mass of the disk. Use your results from (a) and (b) for this purpose.

[10 points]

3. Consider a solid hemisphere of radius R , constant mass density ρ , and a total mass M . Calculate all elements of the inertia tensor (in terms of M and R) of the hemisphere for a reference frame with its origin at the center of the circular base of the hemisphere. Make sure to clearly sketch the hemisphere and axes positions.

[10 points]