

Homework No. 11 (Fall 2023)

PHYS 205A-002: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Due date: Friday, 2023 Dec 1, 2:00 PM, on D2L

Instructions

- You are encouraged to use any of the resources to complete this homework. However, the extent to which you depend on resources while doing homework is usually a measure of how much extra work you need to put in to master the associated concepts. Solutions should be the last resource.
- Describe your thought process in detail and organize it clearly. Make sure your answer has units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assessments → Assignments).

Problems

1. (**10 points.**) A solid sphere, (with $I = \frac{2}{5}MR^2$ when the axis of rotation passes through the center of sphere,) rolls perfectly (without sliding or slipping) on a horizontal surface. The total kinetic energy of the sphere is the sum of the translational kinetic energy and rotational kinetic energy. What percentage of the total kinetic energy of the sphere is in the form of translational kinetic energy.

[\[Solution\]](#)

2. (**10 points.**) A spherical shell, (with $I = \frac{2}{3}MR^2$ when the axis of rotation passes through the center of sphere,) rolls perfectly (without sliding or slipping) on an inclined plane. If the sphere started from rest at the top, from a vertical height of 1.00 m, what is the velocity of the sphere when it reaches the bottom of the incline?

[\[Solution, 2023S FE P06, 2022F FE P06, 2022S FE P07\]](#)

3. (**10 points.**) A solid sphere of radius $a = 0.20$ m, (with moment of inertia $I = \frac{2}{5}Ma^2$ when the axis of rotation passes through the center of sphere,) rolls perfectly (without sliding and slipping) on a surface in the shape of a circle of radius $R = 2.0$ m shown in Figure 1. For what minimum velocity v_i at the bottom of the circle will the sphere be able to go all around?

[\[Solution, 2017F FE P07, 2015F FE P08\]](#)

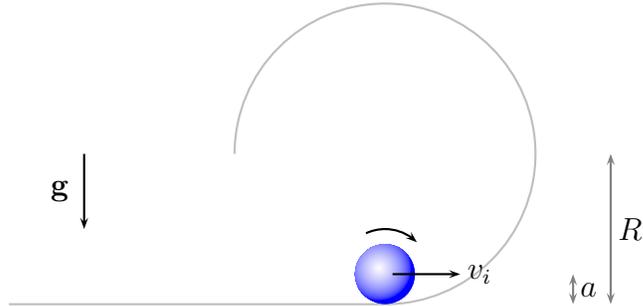


Figure 1: Problem 3.

4. (10 points.) A circular platform in the shape of a disc of radius $R = 2.0$ m and mass $M = 75$ kg is free to rotate about an axis passing through the center of the disc, with the axis perpendicular to the disc, ($I = \frac{1}{2}MR^2$.) A boy weighing 50.0 kg moves inward from the outer edge of the disc to the center of the disc. What is the angular speed of the disc when the boy reaches the center, if the angular speed was 5.0 rad/s when the boy was at the outer edge.

[Solution, 2018S FE P09, 2017F FE P08, 2016F FE P08]

5. (10 points.) The rotational inertia of a collapsing spinning star changes to $\frac{1}{3}$ its initial value. What is the ratio of the new rotational kinetic energy to the initial rotational kinetic energy? (Hint: Angular momentum is conserved in this configuration.)

[Solution, 2017F FE P08, 2014F FE P08]