

Midterm Exam No. 03 (2023 Spring)

PHYS 205A-001: UNIVERSITY PHYSICS

Department of Physics, Southern Illinois University–Carbondale

Date: 2023 Apr 17

(Name)

(Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 50 minutes.
3. There are 4 conceptual questions and 3 problems in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to present your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of smart devices, including smart watches, is strictly prohibited. They should stay out of reach during the exam.
8. Restroom breaks are allowed. Under questionable circumstances this might lead up to a Makeup Exam.
9. Academic misconduct will lead to a failing grade in the course.

1. **(5 points.)** A mass of $m = 25.0$ kg slides down a frictionless incline that makes an angle of $\theta = 30.0^\circ$ with the horizontal. Assume that the mass starts from rest. The two forces acting on the mass during the slide are the normal force and the force of gravity. The mass slides $d = 10.0$ m along the incline. Determine the work done by the normal force.

2. (5 points.) Using the potential energy curve shown in Figure 1 determine the direction of the force at $x = 1.0$ m.

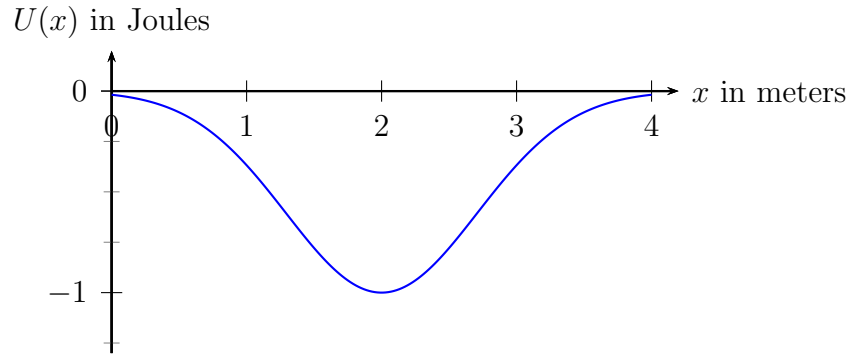


Figure 1: Problem 2.

3. (5 points.) What is the difference between elastic and inelastic collision?

4. (5 points.) The object in Figure 2 is constructed by cutting out two discs of diameter R , out of a circular disc of diameter $2R$, such that the centers of the two discs are on diametrically opposite sides. Assume uniform density of material (shown in blue). Is the center of mass of the object above height R from the baseline shown, at height R , or below height R ?

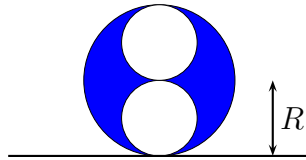


Figure 2: Problem 4.

5. (10 points.) A 25 kg mass slides down a frictionless surface, see Figure 3, from point A to point B starting from rest. Determine the speed at point B if it falls a vertical height of $h = 10.0$ m.

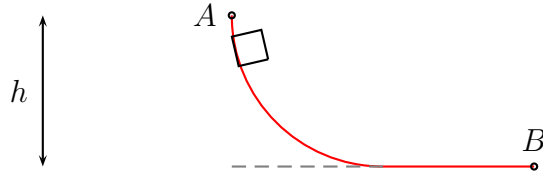


Figure 3: Problem 5.

6. **(10 points.)** A car is moving at speed 35 m/s towards West. A truck four times heavier than the car is moving at speed 21 m/s towards South. They collide at an intersection and get entangled (complete inelastic collision). What is the magnitude and direction of the final velocity of the entangled automobiles?

7. (10 points.) A motorcycle accelerates uniformly from rest and reaches a linear speed of 24.0 m/s in a time of 8.00 s . The radius of each tire is 0.300 m . What is the angular displacement of a point on the rim of one of the tires?