Midterm Exam No. 02 (2024 Spring)

PHYS 205A-001: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale
Date: 2024 Mar 8

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(Name)   (Signature)

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Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.

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.**) The wind is flowing at $15\,\mathrm{m/s}$ towards East with respect to the ground. Determine the direction an aeroplane should head (with respect to the wind) if the aeroplane needs to head North (with respect to the ground) at $45\,\mathrm{m/s}$.

2. (**5 points.**) What is the direction of the acceleration of an object when it is moving in a circle of radius 65 m with uniform speed?

3. (**5 points.**) Newton's third law states that every action force has an equal and opposite reaction force. Then, is it correct to state that the normal force exerted by the surface of Earth on a car at rest on lavel ground and the gravitational force exerted by Earth on the car are action reaction paits.

4. (**5 points.**) A $24\,\mathrm{kg}$ mass is resting on an incline plane that makes an angle of $60.0°$ with respect to the horizontal. Calculate the magnitude and direction of the normal force acting on the mass.

5. (**10 points.**) A mass is held above ground using two ropes as described in Figure 1. Let $m = 20.0 \, \text{kg}$ and $\theta_1 = \theta_2 = 30.0°$. Find the tension in each of the strings.
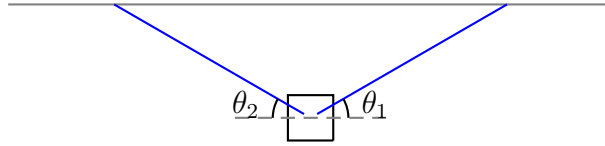

Figure 1: Problem 5.

6. (**10 points.**) A mass $m_2 = 2.0\,\text{kg}$ is connected to another mass $m_1 = 1.0\,\text{kg}$ by a massless (inextensible) string passing over a massless pulley, as described in Figure 2. The coefficient of static friction between mass m_2 and the surface is 0.50 and the coefficient of kinetic friction between them is 0.25. Determine the acceleration of the masses.
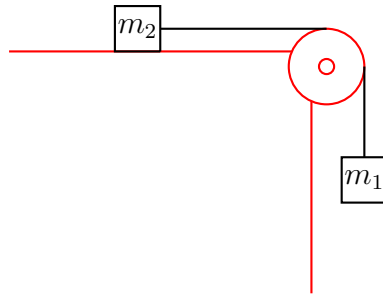

Figure 2: Problem 6

7. (**10 points.**) In the Globe of Death stunt motorcycle stunt riders ride motorcycles inside a mesh globe. In particular, they can loop vertically. Consider a motorcycle going around a vertical circle of 30.0 m radius, inside the globe, with uniform velocity. Determine the minimum speed necessary for the motorcycle to stay in contact with the globe during the complete vertical circle.