# Midterm Exam 02 (2021 Fall)

## PHYS 203A-002: College Physics

Date: 2021 Oct 7

(Name) (Signature)

## Instructions

1. Seating direction: Please be seated on seats with seat numbers divisible by 4.
2. Total time = 75 minutes.
3. There are 9 questions in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**5 points.**) What is the gravitational force exerted by Earth on a spacecraft while it is behind on the far side of Moon. Given mass of spacecraft is 15000 kg, mass of Earth is $6.0 \times 10^{24}$ kg, mass of Moon is $7.4 \times 10^{22}$ kg, radius of Earth is 6400 km, radius of Moon is 1700 km, distance between Earth and Moon is 380,000 km, and the satellite is 110 km above the lunar surface.

2. (**5 points.**) A mass $m$ is held to a vertical wall by pushing on it by a force $\vec{\mathbf{F}}$ exerted horizontally. See Figure 1. What is the direction of the normal force acting on the mass.

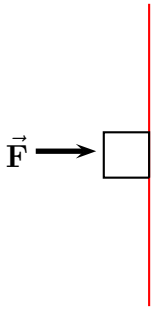


Figure 1: Problem 2

3. (**5 points.**) While walking we push on the floor to move forward. What is the direction of the force of friction acting on a person while walking in a typical human gait.

4. (**5 points.**) A stuntman drives a car with uniform speed over the top of a hill, the cross section of which can be approximated by a circle of radius $R = 150\,\mathrm{m}$. See Figure 2. What is the magnitude and direction of acceleration of the stuntman while moving at $15\,\mathrm{m/s}$ at the highest point on the hill?

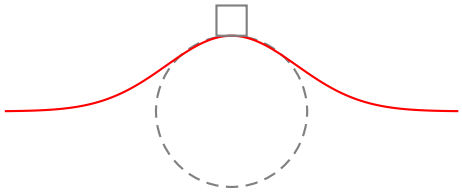

Figure 2: Problem 4

5. (**10 points.**) A student is skateboarding down a ramp that is inclined at 30° with respect to the horizontal. Neglect friction. See Fig. 3. Determine the acceleration of the student.

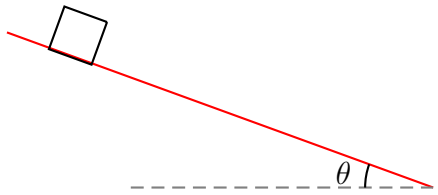


Figure 3: Problem 5.

6. (**10 points.**) A 5.0 kg mass is hanging by a string from the ceiling of an elevator. Determine the force of tension exerted by the string on the mass when the elevator is slowing down at 2.0 $\mathrm{m/s^2}$ while moving upward.

7. (**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 4. Surfaces are frictionless. After starting from rest how far does $m_2$ move in one second?

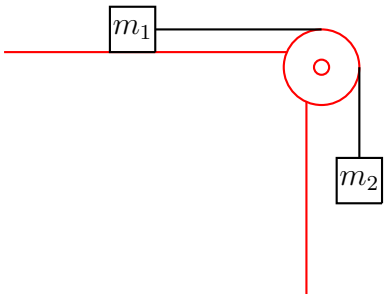


Figure 4: Problem 7

8. (**10 points.**) A trunk with a weight of 196 N rests on the floor. The coefficient of static friction between the trunk and the floor is 0.50, and the coefficient of kinetic friction is 0.40. What is the magnitude of the minimum horizontal force with which a person must push on the trunk to start it moving?

9. (**10 points.**) In the Globe of Death motorcycle stunt riders ride motorcycles inside a mesh globe. In particular, they can loop vertically. Consider a motorcycle going around in a vertical circle of radius 12 m inside the globe, with uniform velocity. What is the minimum speed required if the motorcycle is to stay in contact with the surface of the globe while at the very top?