## PHYS-2010: Dr. Luttermoser's General Physics I Course Problem Set 1, Fall 2023

There are two sections to this Problem Set, the first section of problems are located on the textbook publisher's *WebAssign* web site:

## https://webassign.com

These problems will be graded and must be completed by 6:00 p.m. on Friday, September 22, 2023. Start working on these problems immediately once they are posted on Web-Assign. Don't wait until the last day to start them. One never knows when the network will go down, and you will not be able to use this as an excuse for not doing your WebAssign problems. As a matter of fact, there will be no allowed excuses for not doing your WebAssign homework.

Once you click on the *WebAssign* web site above, click on the "Enter Class Key" button on the upper right of this web page. The class key for this course is:

etsu 9680 9716

A Quick Start Guide for using this web site can be found on the course web page. Should you need additional assistance with *WebAssign*, you can contact Technical Support information at:

https://webassign.com/support/student-support/

via the web or

1-800-354-9706

by telephone.

The following problems will not be graded, but should be done for review. The solutions are posted on the course web page. Try to work these problems out by yourself before looking at the solutions I have supplied for you.

1. The displacement of an object moving under uniform acceleration is some function of time and the acceleration. Suppose we write the displacement as  $x = ka^m t^n$ , where k is a dimensionless constant. Show by dimensional analysis that this expression is satisfied if m = 1 and n = 2. Can the analysis give the value of k?

- 2. A farmer measures the perimeter of a rectangular field. The length of each long side is of the rectangle is found to be 38.44 m, and the length of each short side is found to be 19.5 m. What is the perimeter of the field? (*Hint*: Worry about significant digits.)
- 3. A house is 50.0 ft long and 26 ft wide and has 8.0 ft high ceilings. What is the volume of the interior of the house in cubic meters and in cubic centimeters?
- 4. Two points in a rectangular coordinate system have the coordinates (5.0, 3.0) and (-3.0, 4.0), where the units are centimeters. Determine the distance between these points.
- 5. A high fountain of water is located at the center of a circular pool. Not wishing to get his feet wet, a student walks around the pool and measures its circumference to be 15.0 m. Next, the student stands at the edge of the pool and uses a protractor to gauge the angle of elevation at the bottom of the fountain to be 55.0°. How high is the fountain?
- 6. Two boats start together and race across a 60-km wide lake and back. Boat A goes across at 60 km/hr and returns at 60 km/hr. Boat B goes across at 30 km/hr, and its crew, realizing how far behind it is getting, returns at 90 km/hr. Turnaround times are negligible, and the boat that completes the round trip wins. (a) Which boat wins and by how much? (Or is it a tie?) (b) What is the average velocity of the winning boat?
- 7. Runner A is initially 4.0 mi west of a flagpole and is running at a constant velocity of 6.0 mi/hr due east. Runner B is initially 3.0 mi east of the flagpole and is running with a constant velocity of 5.0 mi/hr due west. How far are the runners from the flagpole when they meet?
- 8. A drag racer starts her car from rest and accelerates at  $10.0 \text{ m/s}^2$  for a distance of 400 m (1/4 mile). (a) How long did it take the race car to travel this distance? (b) What is the speed of the race car at the end of the run?
- 9. A certain freely falling object, released from rest, requires 1.50 s to travel the last 30.0 m before it hits the ground. (a) Find the velocity of the object when it is 30.0 m above the ground. (b) Find the total distance the object travels during the fall.
- 10. A young woman named Kathy Kool buys a sports car that can accelerate at the rate of 4.90 m/s<sup>2</sup>. She decides to test the car by drag racing with another speedster, Stan Speedy. Both start from rest, but experienced Stan leaves the starting line 1.00 s before Kathy. If Stan moves with a constant acceleration of 3.50 m/s<sup>2</sup>, and Kathy maintains an acceleration of 4.90 m/s<sup>2</sup>, find (a) the time it takes Kathy to overtake Stan, (b) the distance she travels before she catches him, and (c) the speeds of both cars at the instant she overtakes him.
- 11. Vector  $\vec{A}$  makes a 30.0° angle with respect to the *x*-axis and has a length of 3.00 m. Vector  $\vec{B}$  also has a length of 3.00 m and lies on the *y*-axis. Graphically and algebraically determine (a)  $\vec{A} + \vec{B}$ , (b)  $\vec{A} \vec{B}$ , (c)  $\vec{B} \vec{A}$ , and (d)  $\vec{A} 2\vec{B}$ .

- 12. The eye of a hurricane passes over Grand Bahama Island in a direction 60.0° north of west with a speed of 41.0 km/hr. Three hours later the course of the hurricane suddenly shifts due north, and its speed slows to 25.0 km/hr. How far from Grand Bahama is the hurricane 4.50 hr after it passes over the island?
- 13. Baseball pitcher Nolan Ryan throws a fast-ball at 101.0 mi/hr. If a pitch was thrown horizontally with this velocity, how far would the ball fall vertically by the time it reaches home-plate, 60.5 ft away?
- 14. A river flows due east at 1.50 m/s. A boat crosses the river from the south shore to the north shore by maintaining a constant velocity of 10.0 m/s due north relative to the water. (a) What is the velocity of the boat relative to the shore? (b) If the river is 300 m wide, how far downstream has the boat moved by the time it reaches the north shore?
- 15. A rocket is launched at an angle of 53.0° above the horizontal with an initial speed of 100 m/s. The rocket moves for 3.00 s along its initial line of motion with an acceleration of 30.0 m/s<sup>2</sup>. At this time, its engines fail and the rocket proceeds to move as a projectile. Find (a) the maximum altitude reached by the rocket, (b) the total time of flight, and (c) its horizontal range.
- 16. The air exerts a forward force of 10 N on the propeller of a 0.20-kg model airplane. If the plane accelerates forward at  $2.0 \text{ m/s}^2$ , what is the magnitude of the resistive force exerted by the air on the airplane?
- 17. Find the tension in each cable (labeled as  $\vec{T_1}$  and  $\vec{T_2}$  in the diagram below) supporting a 600 N mass, where  $\theta_2 = 37.0^{\circ}$ .



- 18. Two people are pulling a boat through the water with ropes. Each exerts a force of 600 N directed at a 30.0° angle with respect to the forward motion of the boat. If the boat moves at a constant velocity, find the resistive force  $\vec{F}$  exerted by the water on the boat.
- 19. Two packing crates of masses 10.0 kg and 5.00 kg are connected by a light string that passes over a frictionless pulley. The 10.0 kg mass hangs vertically from the pulley and

the 5.00 kg mass slides on a frictionless surface that is inclined from the horizontal at an angle of  $40.0^{\circ}$ . Find (a) the acceleration of the 5.00 kg crate and (b) the tension in the string.

- 20. Two objects with masses of 3.00 kg and 5.00 kg are connected by a light string that passes over a frictionless pulley. Determine (a) the tension in the string, (b) the acceleration of each object, and (c) the distance each object will move in the first second of motion if both objects start from rest.
- 21. The coefficient of static friction between a 3.00 kg crate and a 35.0° incline is 0.300. What minimum force  $\vec{F}$  must be applied to the crate perpendicular to the incline to prevent the crate from sliding down the incline?