PHYS-2010: Dr. Luttermoser's General Physics I Course
Problem Set 2, 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, October 20, 2023. **Start working on these problems immediately once they are posted on *WebAssign*. 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. A 0.60–kg particle has a speed of 2.0 m/s at point A and a kinetic energy of 7.5 J at point B. What is (a) its kinetic energy at A? (b) Its speed at point B? (c) The total work done on the particle as it moves from A to B.

2. A 50–kg pole vaulter running at 10 m/s vaults over the bar. Her speed when she is

above the bar is 1.0 m/s. Neglect air resistance, as well as any energy absorbed by the pole, and determine her altitude as she crosses the bar.

3. While running a person dissipates about 0.60 J of mechanical energy per step per kilogram of body mass. If a 60–kg person develops a power of 70 W during a race, how fast is the person running? (Assume a running step is 1.5 m long.)

4. High–speed stoboscopic photographs show that the head of a 200–g golf club is traveling at 55 m/s just before it strikes a 46–g golf ball at rest on a tee. After the collision, the club head travels (in the same direction) at 40 m/s. Find the speed of the golf ball just after impact.

5. Verify that the kinetic energy of the Earth can be ignored when considering the energy of the system consisting of the Earth and a dropped ball of mass m_b. Verify this statement by first setting up a ratio of the kinetic energy of the Earth (note that $\oplus$ is the astronomical symbol for the Earth) to that of the ball as they collide. Then use the conservation of momentum to show that

$$\frac{v_\oplus}{v_b} = -\frac{m_b}{M_\oplus} \quad \text{and} \quad \frac{\text{KE}_\oplus}{\text{KE}_b} = \frac{m_b}{M_\oplus} \ .$$

   Find the order of magnitude of the ratio of the kinetic energies, using a mass for the ball of 1 kg and an approximate mass of the Earth of 10^{25} kg.

6. A 10.0 g object moving to the right at 20.0 cm/s makes an elastic head-on collision with a 15.0 g object moving in the opposite direction at 30.0 cm/s. Find the velocity of each object after the collision.

7. A dentist's drill starts from rest. After 3.20 s of constant angular acceleration, it turns at a rate of 2.52×10^4 rev/min. (a) Find the drill's angular acceleration. (b) Determine the angle (in radians) through which the drill rotates during this period.

8. A sample of blood is placed in a centrifuge of radius 15.0 cm. The mass of a red blood cell is 3.0×10^{-16} kg, and the magnitude of the force acting on it as it settles out of the plasma is 4.0×10^{-11} N. At how many revolutions per second should the centrifuge be operated?

9. During a solar eclipse, the Moon, Earth, and Sun all lie on the same line, with the Moon between the Earth and the Sun. (a) What force is exerted by the Sun on the Moon? (b) What force is exerted by Earth on the Moon? (c) What force is exerted on Earth by the Sun? (See Table 7.3 in the textbook for data.)

10. A 600–kg satellite is in a circular orbit about the Earth at a height above the Earth surface equal to Earth's mean radius. Find (a) the satellite's orbital speed, (b) the period of its revolution, and (c) the gravitational force acting on it.