PHYS-2010: Dr. Luttermoser's General Physics I Course
Problem Set 4, 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 **Monday**, December 4, 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:

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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 cylinder with a movable piston contains gas at a temperature of 27.0°C, a volume of 1.50 m^3, and an absolute pressure of 0.200×10^5 Pa. What will be its final temperature if the gas is compressed to 0.700 m^3 and the absolute pressure increases to 0.800×10^5 Pa?
2. (a) What is the total random kinetic energy of all the molecules in 1 mole of hydrogen at a temperature of 300 K? (b) With what speed would a mole of hydrogen have to

move so that the kinetic energy of the mass as a whole would be equal to the total random kinetic energy of its molecules?

3. The temperature near the top of the atmosphere on Venus is 240 K. (a) Find the rms speed of hydrogen (H_2) at that point in Venus's atmosphere. (b) Repeat for carbon dioxide (CO_2). (c) It has been found that if the rms speed exceeds one-sixth of the planet's escape velocity, the gas eventually leaks out of the atmosphere into outer space. If the escape velocity on Venus is 10.3 km/s, does hydrogen escape? Does carbon dioxide?

4. Before beginning a long trip on a hot day, a driver inflates an automobile tire to a gauge pressure of 1.80 atm at 300 K. At the end of the trip, the gauge pressure has increased to 2.20 atm. (a) Assuming that the volume has remained constant, what is the temperature inside the tire? (b) What percentage of the original mass of air in the tire should be released so that the pressure returns to its original value? Assume that the temperature remains at the value found in part (a) and that the volume of the tire remains constant as air is released.

5. A gas is compressed at a constant pressure of 0.800 atm from 9.00 L to 2.00 L. In the process, 400 J of energy leaves the gas by heat. (a) What is the work done *on* the gas? (b) What is the change in its internal energy?

6. An engine absorbs 1,700 J from a hot reservoir and expels 1,200 J to a cold reservoir in each cycle. (a) What is the engine's efficiency? (b) How much work is done in each cycle? (c) What is the power output of the engine if each cycle lasts 0.300 s?

7. The surface of the Sun is approximately at 5,700 K, and the temperature of the Earth's surface is approximately 290 K. What entropy change occurs when 1,000 J of energy is transferred by heat from the Sun to the Earth?

8. Consider a standard deck of 52 playing cards that has been thoroughly shuffled. (a) What is the probability of drawing the ace of spades in one draw? (b) What is the probability of drawing any ace? (c) What is the probability of drawing any spade?