This print-out should have 11 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points
Pure helium gas is admitted into a tank containing a movable piston. The initial volume, pressure, and temperature of the gas are 0.036 m$^3$, 129 kPa, and 464 K.
If the volume is decreased to 0.012 m$^3$ and the pressure is increased to 400 kPa, find the final temperature of the gas.
Answer in units of K.

002 (part 1 of 2) 10.0 points
A sphere 12 cm in diameter contains an ideal gas at 1.3 atm and 17$^\circ$C. As the sphere is heated to 130$^\circ$C, gas is allowed to escape. The valve is closed and the sphere is placed in an ice-water bath.
How many moles of gas escape from the sphere as it warms?
Answer in units of mol.

003 (part 2 of 2) 10.0 points
What is the pressure in the sphere when it is in the ice water?
Answer in units of Pa.

004 (part 1 of 2) 10.0 points
An air bubble originating from an under-water diver has a radius of 8 mm at some depth $h$. When the bubble reaches the surface of the water, it has a radius of 10.1 mm.
Assuming the temperature of the air in the bubble remains constant, determine the depth $h$ of the diver. The acceleration of gravity is 9.8 m/s$^2$.
Answer in units of m.

005 (part 2 of 2) 10.0 points
Determine the absolute pressure at this depth.
Answer in units of kPa.

006 10.0 points
An auditorium has dimensions 4 m height, 18 m length, and 20 m width.
How many molecules of air are needed to fill the auditorium at 28$^\circ$C and 99 kPa pressure?

007 (part 1 of 2) 10.0 points
A tank of volume 0.467 m$^3$ contains 1.74 mol of helium gas at 79$^\circ$C. Assume that the helium behaves like an ideal gas.
The universal gas constant is 8.31451 J/K mol, and Boltzmann’s constant is $1.38066 \times 10^{-23}$ J/K.
Find the total thermal energy of the system.
Answer in units of J.

008 (part 2 of 2) 10.0 points
What is the average kinetic energy per molecule?
Answer in units of J.

009 10.0 points
Gaseous helium is in thermal equilibrium with liquid helium at 9.9 K.
The mass of a helium atom is $6.65 \times 10^{-27}$ kg. Boltzmann’s constant is $1.38066 \times 10^{-23}$ J/K.
Determine the most probable speed of a helium atom.
Answer in units of m/s.

010 (part 1 of 2) 10.0 points
Boltzmann’s constant is $1.38066 \times 10^{-23}$ J/K. Avogadro’s number is $6.02214 \times 10^{23}$ /mol.
Determine the temperature at which the rms speed of an He atom equals 720 m/s.
Answer in units of K.

011 (part 2 of 2) 10.0 points
What is the rms speed of He on the surface of a certain star, where the temperature is 4500 K?
Answer in units of m/s.