

CLASS: PHY _____

STUDENT #: _____

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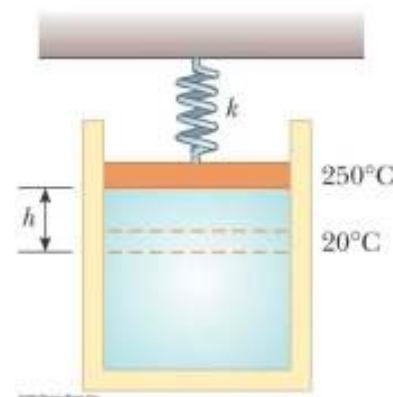
Assignment 9: Ideal Gas Equation First Law of Thermodynamics

Assigned: Monday Nov 14 Due: Monday Nov 21 19:00

1 An automobile tire is inflated with air originally at 10.0°C and normal atmospheric pressure. During the process, the air is compressed to 28.0% of its original volume and the temperature is increased to 40.0°C . (a) What is the tire pressure? (b) After the car is driven at high speed, the tire air temperature rises to 85.0°C and the interior volume of the tire increases by 2.00%. What is the new tire pressure (absolute) in pascals?

2 Just 9.00 g of water is placed in a 2.00-L pressure cooker and heated to 500°C . What is the pressure inside the container?

3 A cylinder is closed by a piston connected to a spring of constant $2.00 \times 10^3 \text{ N/m}$ (see Fig. P19.50). With the spring relaxed, the cylinder is filled with 5.00 L of gas at a pressure of 1.00 atm and a temperature of 20.0°C . (a) If the piston has a cross-sectional area of 0.0100 m^2 and negligible mass, how high will it rise when the temperature is raised to 250°C ? (b) What is the pressure of the gas at 250°C ?



4. An aluminum calorimeter with a mass of 100 g contains 250 g of water. The calorimeter and water are in thermal equilibrium at 10.0°C . Two metallic blocks are placed into the water. One is a 50.0-g piece of copper at 80.0°C . The other block has a mass of 70.0 g and is originally at a temperature of 100°C . The entire system stabilizes at a final temperature of 20.0°C . (a) Determine the specific heat of the unknown sample. (b) Guess the material of the unknown, using the data in the textbook.

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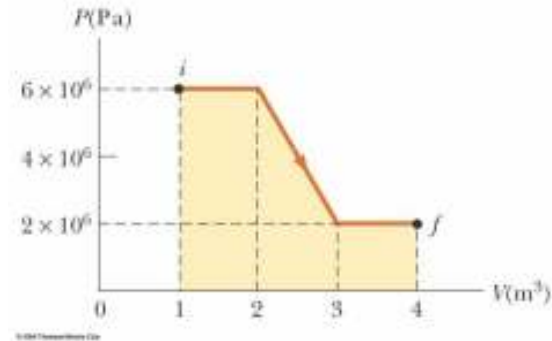
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Assignment 9: CONT

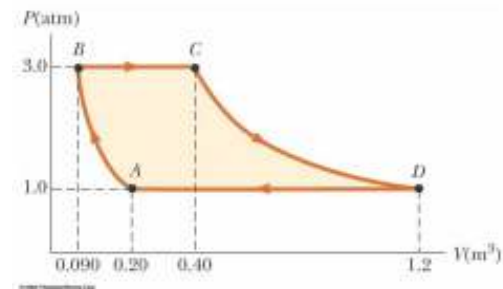
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5. A 1.00-kg block of copper at 20.0°C is dropped into a large vessel of liquid nitrogen at 77.3 K. How many kilograms of nitrogen boil away by the time the copper reaches 77.3 K? (The specific heat of copper is 0.092 0 cal/g·°C. The latent heat of vaporization of nitrogen is 48.0 cal/g.)

6. (a) Determine the work done on a fluid that expands from i to f as indicated in Figure (b) How much work is performed on the fluid if it is compressed from f to i along the same path?



7. A sample of an ideal gas goes through the process shown in Figure P20.32. From A to B , the process is adiabatic; from B to C , it is isobaric with 100 kJ of energy entering the system by heat. From C to D , the process is isothermal; from D to A , it is isobaric with 150 kJ of energy leaving the system by heat. Determine the difference in internal energy $E_{\text{int},B} - E_{\text{int},A}$.



8. Assume that the Earth's atmosphere has a uniform temperature of 20°C and uniform composition, with an effective molar mass of 28.9 g/mol. (a) Show that the number density of molecules depends on height according to

$$n_V(y) = n_0 e^{-mgy / k_B T}$$

where n_0 is the number density at sea level, where $y = 0$. This result is called the *law of atmospheres*. (b) Commercial jetliners typically cruise at an altitude of 11.0 km. Find the ratio of the atmospheric density there to the density at sea level.