**PHYSICS 2, CHAPTER 3**

**ADDITIONAL PROBLEMS**

**1.** Air that initially occupies 0.140 m3 at a gauge pressure of 103.0 kPa is expanded isothermally to

a pressure of 101.3 kPa and then cooled at constant pressure until it reaches its initial volume. Compute the work done by the gas. (Gauge pressure is the difference between the actual pressure and atmospheric pressure*.)*

**2**. An automobile tire has a volume of 1 .64 × 10-2 m3 and contains air at a gauge pressure (pressure above atmospheric pressure) of 165 kPa when the temperature is 0.000C. What is the gauge pressure of the air in the tires when its temperature rises to 27 .00C and its volume increases to 1.67 × 10-2 m3? Assume atmospheric pressure is 1.01 × 105 Pa.

**3.** Oxygen gas having a volume of 1000 cm3 at 40.0oC and 1.01 × 105 Pa expands until its volume is 1500 cm3 and its pressure is 1.06 × 105 Pa.

Find (a) the number of moles of oxygen present and

(b) the final temperature of the sample.

**4.** (a) Compute the rms speed of a nitrogen molecule at

20.0oC. The molar mass of nitrogen molecules (Nr) is given

in Table 19-1.

At what temperatures will the rms speed be

(b) half that value and

(c) twice that value?

(d) What is the average translational kinetic energy of nitrogen molecules at 1600 K?

**5.** Determine the average value of the translational kinetic

energy of the molecules of an ideal gas at

(a) 0.00oC and

(b) 100oC.

What is the translational kinetic energy per mole of an ideal gas at

(c) 0.00oC and

(d) 100oC?

**6.** The temperature of 2.00 mol of an ideal monatomic gas is raised 15.0 K at constant volume. What are

(a) the work done by the gas,

(b) the energy transferred as heat,

(c) the change in the internal energy of the gas, and

(d) the change in the average kinetic energy per atom?

**7.** The temperature of 3.00 mol of an ideal diatomic gas is increased by 40.0 oC without the pressure of the gas changing. The molecules in the gas rotate but do not oscillate.

(a) How much energy is transferred to the gas as heat?

(b) What is the change in the internal energy of the gas?

(c) How much work is done by the gas?

**8.** Suppose 4.00 mol of an ideal diatomic gas, with molecular rotation but not oscillation, experienced a temperature increase of 60.0 K under constant-pressure conditions. What are

(a) the energy transferred as heat,

(b) the change in internal energy of the gas,

(c) the work done by the gas, and

(d) the change in the total translational kinetic energy of the gas?

**9**. A certain gas occupies a volume of 4.3 L at a pressure of 1.2 atm and a temperature of 310 K. It is compressed adiabatically to a volume of 0.76 L. Determine

(a) the final pressure and

(b) the final temperature, assuming the gas to be an ideal gas for which γ = 1.4.

**10.** An ideal monatomic gas initially has a temperature of 330 K and a pressure of 6.00 atm. It is to expand from volume 500 cm3 to volume 1500 cm3. If the expansion is isothermal, what are

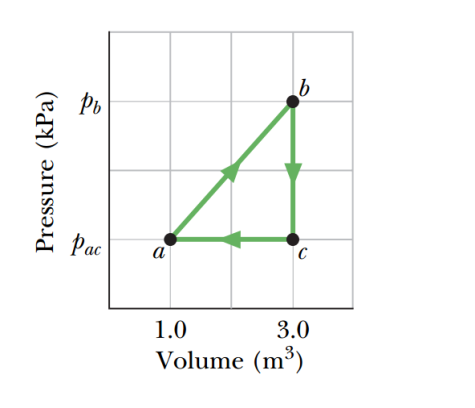
(a) the final pressure and

(b) the work done by the gas?

If, instead, the expansion is adiabatic, what are

(c) the final pressure and

(d) the work done by the gas?

**11.**A sample of an ideal gas is taken through the cyclic process *abca* shown in Fig. 19-20. The scale of the vertical axis is set by *pb* =7.5 kPa and *pac* = 2.5 kPa. At point *a*, *T* = 200 K.

(a) How many moles of gas are in the sample?

What are

(b) the temperature of the gas at point *b*,

(c) the temperature of the gas at point *c*, and

(d) the net energy added to the gas as heat during the cycle?

**12.** In the temperature range 310K to 330 K, the pressure *p* of a certain non-ideal gas is related to volume *V( )* and temperature *T* by

How much work is done by the gas if its temperature is raised from 315 K to 325 K while the pressure is held constant?

**13.** An air bubble of volume 20 cm3 is at the bottom of a lake 40 m deep, where the temperature is 4.0°C. The bubble rises to the surface, which is at a temperature of 20°C.Take the temperature of the bubble’s air to be the same as that of the surrounding water. Just as the bubble reaches the surface, what is its volume?

**14.** A beam of hydrogen molecules (H2) is directed toward a wall, at an angle of 55° with the normal to the wall. Each molecule in the beam has a speed of 1.0 km/s and a mass of 3.3x g.The beam strikes the wall over an area of 2.0 cm2, at the rate of molecules per second.

What is the beam’s pressure on the wall?

**15.** At 273 K and atm, the density of a gas is 1.24x g/cm3.

(a) Find vrms for the gas molecules.

(b) Find the molar mass of the gas and

(c) identify the gas. (Hint: The gas is listed in Table 19-1.)

Answers key:

1. 5.60 kJ

2. 186 kPa

3. (a) 0.0388 mol; (b) 220 oC

4. (a) 511 m/s; (b) -200oC; (c) 899oC; (d) 2.5x J

5. (a) 5.65 x J ; (b) 7.72 x J; (c) 3.4 k J;(d) 4.65 kJ

6. (a) 0; (b) +374J; (c) +374J; (d) +3.11 x J

7. (a) 3 .49 kJ; (b) 2.49 kJ; (c) 997 J; (d) 1.00 kJ

8. (a) 6.98 kJ; (b) 4.99kJ; (c) I.99 kJ; (d) 2.99kJ

9. (a) 14 atm; (b) 620 K

10. (a) 2.00 atm; (b) 333 J; (c) 0.961 atm;(d) 236 J

11. (a) 1.5041 mol ; (b) 1800K; (c) 600K;(d) 5 kJ

12. 310J

13. 100

14. 1894 Pa

15. (a) 494 m/s; (b) 27.9 g/mol; (c)