

**Sixth Problem Set Phy132**  
**Due Friday, May 29**

**Problem 1.**

At room temperature and atmospheric pressure,  $N_2$  has an R.M.S. velocity of 511 m/s. What is the R.M.S. velocity of  $He$  under the same conditions?

**Problem 2.**

The best vacuum that can be produced in the laboratory is around  $10^{-18}$  atmospheres. How many molecules are there per cubic centimeter at room temperature ( $300^\circ K$ )?

**Problem 3.**

The pressure  $P$ , volume  $V$ , and temperature  $T$  for a certain substance are related by the equation:

$$P = \frac{AT - BT^2}{V} \quad (1)$$

Find an expression for the work done by the material if the temperature changes from  $T_1$  to  $T_2$  for an isobaric process.

**Problem 4.**

A glass window pane has an area of  $1 \text{ m}^2$ , and a thickness of 6 mm. The temperature outside is  $40^\circ C$ , and the temperature inside is  $20^\circ C$ . How much energy (heat) flows through the window pane each hour?

**Problem 5.**

A bar of gold is in thermal contact with a bar of silver of the same area. The length of the gold bar is 2 cm, and the length of the silver bar is 4 cm. The end of the gold bar is kept at  $80^\circ C$ , and the end of the silver bar is kept at  $20^\circ C$  as shown on the figures page.

When the heat flow reaches steady state, what is the temperature at the junction where the gold and silver meet?

**Problem 6.**

A container contains one mole of  $He$  is initially at a temperature of  $300^\circ K$ , and a volume of  $2 \times 10^{-3} \text{ m}^3$ . Another container contains one mole of  $O_2$  also at a temperature of  $300^\circ K$  and a volume of  $2 \times 10^{-3} \text{ m}^3$ . For each container, the volume is reduced adiabatically to a volume of  $10^{-3} \text{ m}^3$ . What is the final temperature in each case?

**Problem 7.**

One mole of a monatomic gas starts off at a pressure of  $10^5$  Pa, and a volume of  $10^{-3}$  m<sup>3</sup>. The pressure is increased at constant volume to a value of  $2 \times 10^5$  Pa. The gas is then expanded adiabatically to the original pressure. Finally, the gas is compressed at constant pressure to the original state. See the figure on the last page.

Fill in the chart below:

Process	$Q$	$W_{by\ gas}$	$\Delta U$
$A$ to $B$			
$B$ to $C$			
$C$ to $A$			
Complete Cycle			

**Problem 8.**

Two moles of a monatomic gas are initially at a volume  $V_1$  and a pressure  $P_1$ . The pressure and volume slowly doubled to the state with volume  $2V_1$  and pressure  $2P_1$ . The process following a line in the  $P-V$  plane as shown in the figure on the last page.

Find the work  $W$  done, the heat transfer  $Q$ , and the change in internal energy  $\Delta U$  for the process. Express your answer in terms of  $P_1$ ,  $V_1$  and  $R$ .

Figures for Homework 6

