

Quiz #4  
Name \_\_\_\_\_

Week: Sept. 19 -Sept. 21  
Chemistry 331

Equations:

$$PV = nRT, \quad V_m = \frac{V}{n}, \quad U_m = \frac{3}{2}RT, \quad u = \sqrt{\frac{3RT}{M}}, \quad E = \frac{h^2 n^2}{8mL^2}$$

$$P = P_0 \exp \left\{ -\frac{Mgh}{RT} \right\}$$

$$R = 8.31 \text{ J/mol-K} = 0.08206 \text{ L-atm/mol-K}$$

PLEASE INCLUDE UNITS IN YOUR ANSWER!

1. What is the kinetic energy of the gas in the cylinder of an engine where  $n = 0.01$  moles and the temperature is 450 K?

Solution:

$$U_m = 3/2RT = 1.5(8.31 \text{ J/mol-K})(450 \text{ K}) = 5609 \text{ J/mol}$$

$$U = nU_m = (10^{-2} \text{ mol})(5609 \text{ J/mol}) = 56.1 \text{ J}$$

Kinetic energy = \_\_\_\_\_.

2. What is the pressure at the top of K-2, 9000 m above sea level?

Solution Assume that the atmospheric  $M$  is the average of 80%  $N_2$  and 20%  $O_2$ .  
Thus,  $M = 29 \text{ g/mol}$  or  $0.029 \text{ kg/mol}$

$$\begin{aligned} P &= P_0 \exp \{-Mgh/RT\} \\ &= (1 \text{ atm}) \exp \{-(0.029)(9.8)(9000)/(8.31)(298)\} \\ &= 0.35 \text{ atm (gasp)} \end{aligned}$$

The pressure is \_\_\_\_\_.

3. Determine the volume of a 6 cylinder engine that has the following properties. The initial volume is 0.0134, initial pressure is 20 atm and the combustion temperature is 420 K.

Solution:

In this problem you need to solve for  $n$  first. This is a slight twist from the problem worked in class. You are given  $P_1, V_1$  and  $T$  so

$$n = P_1 V_1 / RT = (0.08206 \text{ L-atm})(420 \text{ K}) / (0.0134 \text{ L})(20 \text{ atm}) = 0.0077 \text{ moles}$$

$$V_2 = nRT/P_2 = (0.0077 \text{ mol})(0.08206 \text{ L-atm})(420 \text{ K}) / (1 \text{ atm}) = 0.266 \text{ L}$$

Since there are eight cylinders the total volume is 6 times  $V_2$  or 1.6L

It is a 1.6L engine.

Volume = \_\_\_\_\_.