KING FAHD UNIVERSITY OF PERTOLEUM & MINERALS
PHYSICS DEPARTMENT
QUIZ #4- CHAPTER 19

NAME: Key ID# SECTION# 37

1. A diatomic ideal gas undergoes a constant pressure process in which its internal energy increases by 540 J. Find the heat added to the gas and the work done by the gas.

$$\Delta E_{int} = n C_V \Delta T = 540\,J$$

$$\Rightarrow n \Delta T = \frac{540}{C_V} = \frac{540}{\frac{5}{2}R} = \frac{1080}{5 \times 8.31} \simeq 26$$

$$Q = n C_p \Delta T = \frac{7}{2} R \times 26 = \frac{7}{2} \times 8.31 \times 26$$

$$\boxed{Q = 756\,J}$$

$$\Delta E_{int} = Q - W \Rightarrow W = Q - \Delta E_{int}$$

$$W = 756 - 540 = \boxed{216\,J}$$

2. An ideal diatomic gas, initially at a pressure Pi = 1.0 atm and volume Vi = 3 L, is allowed to expand isothermally until its volume doubles. Find the work done by the gas.

$$W = nRT \ln\left(\frac{V_f}{V_i}\right) =$$

$$= p_i V_i \ln\left(\frac{V_f}{V_i}\right) = 1 \times 1.01 \times 10^5 \times 3 \times 10^{-3} \ln\left(\frac{6}{3}\right)$$

$$\boxed{W = 210\,J}$$

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1. 10 moles of oxygen gas (diatomic) at 20 degrees Celsius is confined in a cube. What is the internal energy of the gas?

$$E_{int} = n C_V T = n \frac{5}{2} R T$$

$$= 10 \times \frac{5}{2} \times 8.31 \times 293 = \boxed{60870\ J}$$

2. An ideal monatomic gas expands at constant pressure of 1.0×10^5 Pascal from a volume of 1.0 L to to a volume of 3.0 L. What is the heat energy transfer during this process?

$$Q = n C_p \Delta T = n \frac{5}{2} R \frac{P \Delta V}{n R}$$

$$Q = \frac{5}{2} P \Delta V = \frac{5}{2} \times 1 \times 10^5 \times 2 \times 10^{-3}$$

$$\boxed{Q = 500\ J}$$

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1. An ideal diatomic gas expands adiabatically. If the final temperature is half the initial temperature, find V_f/V_i?

$$T_i V_i^{\gamma-1} = T_f V_f^{\gamma-1} \qquad \gamma = \frac{C_p}{C_V} = \frac{7}{5} = 1.4$$

$$\left(\frac{V_f}{V_i}\right)^{\gamma-1} = \frac{T_i}{T_f} \Rightarrow \frac{V_f}{V_i} = \left(\frac{T_i}{T_f}\right)^{\frac{1}{\gamma-1}}$$

$$\frac{V_f}{V_i} = (2)^{\frac{1}{0.4}} = \boxed{5.7}$$

2. A monatomic ideal gas is compressed at a constant pressure of 1.5 atm from a volume of 70 liters to 35 liters. Calculate the change in internal energy of the gas in Joules.

$$\Delta E_{int} = n\, C_V\, \Delta T$$

$$= \cancel{n} \frac{3}{2} \cancel{R} \frac{P \Delta V}{\cancel{n} \cancel{R}}$$

$$= \frac{3}{2} P \Delta V = \frac{3}{2} \times 1.5 \times 1.01 \times 10^{5} \times (-35 \times 10^{-3})$$

$$\boxed{\Delta E_{int} = 7954\ J}$$