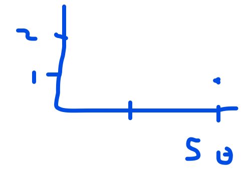


PHYS101-21S1 - Tutorial 7

1. Consider a piston – cylinder arrangement in which two moles of an ideal gas does 6 000 J of work as the piston is pushed outwards isothermally until it reaches a final pressure of 1.00 atm and volume of 50.0 litres. Determine

   (a) the temperature of the gas, and

   (b) the initial volume.

$Q = -6000$

$PV = nrT$

$T = \frac{PV}{nr} = \frac{1 \times 50}{2 \times r}$

$= 2.9K$

$W = nrt \ln\left(\frac{v_f}{V_i}\right)$

$V_i = 3 \times 10^{-5} l$

2. An ideal monatomic gas is compressed adiabatically* from an initial volume V_i to a final volume V_f. During this process, the pressure depends on the volume according to the equation $P = P_i\,(V_i/V)^{5/3}$.

   (a) Derive an expression for the work done. You will need to use the fact that $\int x^n\,dx = \frac{x^{n+1}}{n+1}$

   $\int P = P_i (V_i/v)^{5/3}\,dx$ $\quad W = \frac{3 \times P_i\,(V_i/V)^{8/3}}{8}$

   (b) If V_i = 500 litres and V_f = 200 litres, and the gas was initially at atmospheric pressure, ~~find a~~ numerical value for the work done in the compression.

   $W = \frac{3 \times 1\left(\frac{500}{200}\right)^{8/3}}{8} = 4.32J$

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

   $U = 4.32J$

** Adiabatically means "with no heat transfer". We will derive the formula for the pressure as a function of volume in a later lecture, but you can do this problem without understanding the derivation.*

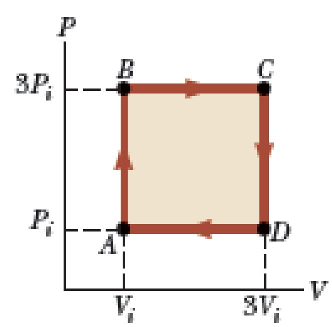
3. An ideal monatomic gas initially at P_i = 2 atm, V_i = 5 litres, and T_i = 20°C is taken through a cycle as shown in the Figure at right.

   (a) Find the net work done on the gas per cycle.

   (b) What is the net energy added by heat to the gas per cycle?

   (c) What is the change in temperature between points A and C?

   [From the change in temperature you could find the change in internal energy – see a later lecture.]



$10 \times 4 = -40J = W$

$40J = Q$

$40K$