

CLASS: PHY \_\_\_\_\_

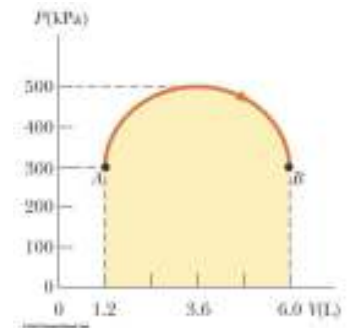
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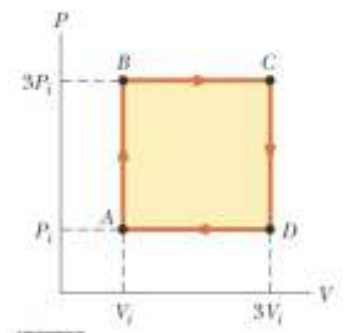
Assignment 10: First Law,  
Maxwell- Boltzmann Speed Distribution  
Assignment Nov 21 Due: Nov 30 (Wed)

- 1 prove that  $pV^\gamma = \text{const.}$  for adiabatic gas transformations. (use the opposite blank page from this)
- 2 An ideal gas initially at 300 K undergoes an isobaric expansion at 2.50 kPa. If the volume increases from  $1.00 \text{ m}^3$  to  $3.00 \text{ m}^3$  and 12.5 kJ is transferred to the gas by heat, what are
  - (a) the change in its internal energy
  - (b) the work done by the gas

- 3 A sample of an ideal gas is in a vertical cylinder fitted with a piston. As 5.79 kJ of energy is transferred to the gas by heat to raise its temperature, the weight on the piston is adjusted so that the state of the gas changes from point A to point B along the semicircle shown in Figure P20.33. Find the change in internal energy of the gas.



4. An ideal gas initially at  $P_i$ ,  $V_i$  and  $T_i$  is taken through a cycle as in the diagram shown (a) Find the net work done on the gas per cycle. (b) What is the net energy added by heat to the system per cycle? (c) Obtain a numerical value for the net work done per cycle for 1.00 mol of gas initially at  $0^\circ\text{C}$ .



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# Assignment 10: CONT.

Assigned Nov 21

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5 The following are the total energy expressions for certain molecules:

$$a) \bar{E}_{kin} = \frac{1}{2} m \bar{v}_x^2 + \frac{1}{2} m \bar{v}_y^2 + \frac{1}{2} m \bar{v}_z^2 + \frac{1}{2} I \bar{\omega}_x^2 + \frac{1}{2} I \bar{\omega}_y^2$$

$$b) \bar{E}_{kin} = \frac{1}{2} m \bar{v}_x^2 + \frac{1}{2} m \bar{v}_y^2$$

i) Find the internal energy of 1 mole of each of these gases

ii) What type of systems are these molecules part of ? / 3D ideal gas, 2\_D crystal etc)

6 What is the total average energy of a molecule having f degrees of freedom?

What is the internal energy of n moles of gas made of such molecules?

How does it compare to the internal energy of n moles of ideal gas?

7 Find the average speed (in m/s) and average kinetic energy (in eV) of a hydrogen molecule at:

i) 10K

ii) 300K

iii) 1000K

8 Using the value of Gaussian integrals ( mathematical appendix) obtain the following relations for the Maxwell Boltzmann speed Distributions

$$v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$$