Answers- Week 13

13-1. $PV = Nk_BT$ $\theta_{Room} = 20°C$

$$\frac{N}{V} = \frac{P}{k_BT} = 3 \times 10^{11}/m^3$$

13-3. $<\underset{\rightarrow}{V}> = 0$ because the velocity of the molecules are totally random.

13-5. Kinetic Energy $= \frac{3}{2}k_\beta T$

(i) Since the gases are in equilibrium, the kinetic energies are same.

(ii) $V_{rms} = \sqrt{\frac{3k_BT}{m}}$

So $\frac{V_{rms}(He)}{V_{rms}(Kr)} = \sqrt{\frac{84}{4}} = 4.6$

So the He atoms are faster by a factor of 4.6.

13-7. For the Pvs V diagram the work done is the area under the graph. Hence W_{ABD} is largest, W_{ACD} is least.

13-9. (i) Process is isochoric, no change in volume, so work done is zero.

(ii) $\Delta u = 3 \times \frac{3}{2} \times R \times \Delta T = 2637$ Calories (11038 Joules)

13-11. (i) The Internal Energy is a thermodynamic potential, its change is independent of the thermodynamic path being controlled by only the end points so for a cyclic process $\Delta u_{cycle} = 0$.

(ii) From A to B gas is expanding so gas is doing work, from B to A operator is pushing piston so operator is doing the work. Since gas does more work, HEAT must be added into the system to carry out the cycle.

13-13. Isochoric – Volume is constant.
No work done. DQ = du
Heat goes to change temperature and pressure.

Isobaric – Pressure is constant. Work is being done. Needs more heat to come same change of temperature as in isochoric.

Isothermic – Temperature is constant. No change in internal energy. All the heat added or subtracted is equal to the work done by or on the gas, respectively.

Adiabatic – No heat leaves or enters the system. If the gas expands, it does work at the expense of its internal energy. If the operator pushes the piston the work goes to increase the internal energy.

$$\gamma = \frac{Cp}{Cv}$$

$$\gamma > 1$$

Where an adiabatic curve and an isothermic curve intersect, the former is steeper became $\gamma > 1$.