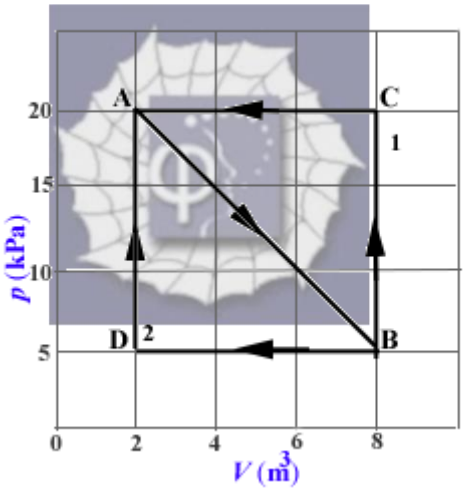
212.

Problem 23.37 (RHK)

Suppose that a sample of gas expands from 2.0 *to* 8.0 m^3 *along the diagonal path as shown in the figure. It is then compressed back to* 2.0 m^3 *either along path* 1 *or along path* 2. *We have to compute the net work done on the gas for the complete cycle in each case.*



Solution:

From the data we find the equation of the diagonal line. It is

$$P = -\frac{5}{2}V + 25, \text{ (P is in kPa and V is in m}^3\text{)}.$$

Work done on a gas is given by

$$W = -\int PdV \ .$$

Therefore, the work done on the gas along the diagonal (A to B) as shown in the figure will be

$$W_{diag} = -\int_{2}^{8}\left(-\frac{5}{2}V + 25\right)dV \text{ kJ} = -75 \text{ kJ}.$$

Work done along BC is zero as the change in pressure takes place at constant volume.

The work done on the gas along CA, as it is compression at constant pressure, will be

$$W_{CA} = -20\times(2-8) \text{ kJ} = 120 \text{ kJ}.$$

Therefore, the total work done on the gas along the cyclic path ABCA will be

$$W(1) = (-75+120) \text{ kJ} = 45 \text{ kJ}.$$

Work done on the gas along the path BD will be

$$W_{BD} = -2\times(2-8) \text{ kJ} = 12 \text{ kJ}.$$

Therefore, the total work done on the gas along the cyclic path ABDA will be

$$W(2) = (-75+12) \text{ kJ} = -45 \text{ kJ}.$$