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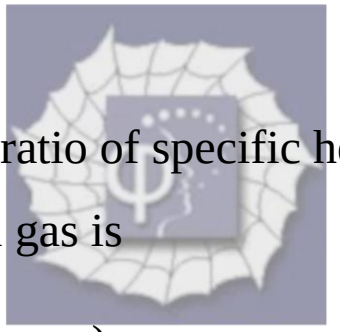
Problem 25.35 (RHK)

(a) *A monatomic ideal gas initially at* 19.0^0C *is suddenly compressed to one-tenth its original volume. We have to find the temperature after compression.*

(b) *We have to do the same calculation for a diatomic gas.*

Solution:



We recall that the ratio of specific heats for monatomic and diatomic ideal gas is

$\gamma = \frac{5}{3}$, (monatomic gas)

and

$\gamma = \frac{7}{5}$. (diatomic gas).

In adiabatic process

$TV^{\gamma-1} = \text{constant.}$

(a)

Initial temperature of the gas is

$T_i = \left(273.16 + 19\right)\ \text{K} = 292.16\ \text{K.}$

We next calculate the temperature of the gas on adiabatic compression to one-tenth of its volume.

$$T_f = T_i \times \left(\frac{V_i}{V_f} \right)^{\gamma - 1} = 292.16 \times 10^{\gamma - 1} \text{ K.}$$

(a)

Temperature of the monatomic ideal gas after compression will be

$$T_f = 292.16 \times 10^{2/3} \text{ K} = 1354 \text{ K} = 1081^0 \text{ C.}$$

(b)

Temperature of the diatomic ideal gas after the adiabatic compression will be

$$T_f = 273.16 \times 10^{2/5} \text{ K} = 734 \text{ K} = 461^0 \text{C.}$$