Answer on Question #60517, Physics /

a closed vesswl having capacity200ml is filled with hydrogen gas STP. calculate:

number of moles of hydrogen gas filled in the vessel

pressure of hydrogen gas in the vessel ai 273 degree c

root mean square velocity of hydrogen gas at STP

the value of Cp and Cv for hydrogen gas

Find:
$$v - ? p - ? u - ? Cp - ? Cv - ?$$

Given:

Т₀=273 К

 $P_0=10^5 Pa$

R=8,31 J/mol

T=273+273 K=546 K

i=5

Solution:

Equation of state for ideal gas:

$$p_0 V = \frac{m}{M} R T_0$$
 (1)

Number of moles:

$$\upsilon = \frac{m}{M}$$
 (2),

where M – molar mass

Of (1) and (2) $\Rightarrow \upsilon = \frac{p_0 V}{RT_0}$ (3)

Of (3) \Rightarrow υ =8,8×10⁻³ mol

Pressure of hydrogen gas:

p = nkT (4)

Concentration:

$$n = \frac{N}{V}$$
 (5)

Number of molecules:

$$N = \nu N_A (6)$$

Of (6) \Rightarrow N=53×10²⁰ (7)

Of (5) \Rightarrow n = 0,26 $\times 10^{26} \frac{1}{m^3}$ (8)

(7) and (8) in (4): p=200×10³ Pa

Root mean square velocity:

$$u = \sqrt{\frac{3RT_0}{M}} (9),$$

where T₀=273 K (gas at STP)

Of (9) \Rightarrow u=1840 m/s

Molar heat of the gas at constant volume:

$$C_v = \frac{i}{2} R$$
 (10),

where i - number of degrees of freedom

Of (10) $\Rightarrow\,$ C_v=20,78 J/K

Molar heat of gas at constant pressure:

$$C_{\rm p} = \frac{i+2}{2} R$$
 (11)

Of (11) $\Rightarrow\,$ C_p=29,08 J/K

Answer:

number of moles: $v=8,8\times10^{-3}$ mol

pressure of hydrogen gas in the vessel ai 273 degree c: p=200×10³ Pa

root mean square velocity of hydrogen gas at STP: u=1840 m/s

the value of Cp and Cv for hydrogen gas: C_v =20,78 J/K, C_p =29,08 J/K

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