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12-1~5 C D C B B

12-6：由 $pV=NkT$，V不变则

$$P_2=\frac{T_2}{T_1}P_1=\frac{273+37}{273+7}\times 4\times 10^5\ pa$$

$$=\frac{310}{280}\times 4\times 10^5\ pa=4.43\times 10^5\ pa$$

12-7：由 $pV=\nu RT$

得 $\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}$　$P_1=P_0+\rho gh$　$P_2=P_0$　得 $V_2=6.11\times 10^{-5}m^3$

$V_1=1\times 10^{-5}m^3$　$V_2=V_2$

$T_1=277\ K$　$T_2=290K$

12-10 (1) 由 $p=nkT$ 得 $n=\frac{P}{kT}=\frac{1.01\times 10^5\ pa}{k\times 300}=2.44\times 10^{25}\ m^{-3}$

(2) $\rho=nm=n\frac{M}{N_A}=1.3\ kg/m^3$

(3) $\bar{\varepsilon}_{ke}=\frac{3}{2}kT=6.21\times 10^{-21}\ J$

(4) $\bar{d}=\sqrt[3]{\frac{1}{n}}=3.45\times 10^{-9}\ m$

12-11 $\bar{\varepsilon}_{ke}=\frac{3}{2}kT$ 又 $p=nkT$　$n=\frac{N}{V}=\frac{1}{V}\times\frac{m}{M}\times N_A$

得 $\bar{\varepsilon}_{ke}=\frac{3}{2}\times\frac{P}{n}=\frac{3P}{2}\times\frac{MV}{mN_A}=3.89\times 10^{-22}\ J$

12-12 $\bar{\varepsilon}_{ke}=\frac{3}{2}kT$　$T_1=273K$　$T_2=373K$

$1eV=E=$　$\frac{3}{2}kT=E$　$T=7.73\times 10^3K$

12-13 由 $pV=\nu RT$　∵ p、V、T 相等 ∴ ν 相等.

$$\therefore\frac{m(H_2)}{m(He)}=\frac{\nu M(H_2)}{\nu M(He)}=\frac{2}{4}=\frac{1}{2}$$

$$\frac{E(H_2)}{E(He)}=\frac{\frac{5}{2}RT}{\frac{3}{2}RT}=\frac{5}{3}$$

12-14 (1) $\bar{\varepsilon}_{ke}=\frac{3}{2}kT=2.07\times 10^{-5}\ J$

(2) $v_{rms}=\sqrt{\frac{3RT}{M}}=\sqrt{3RT}=1.58\times 10^6\ m/s$

12-18 (1) $E = \nu \times \frac{5}{2} RT$ $pV = \nu RT = \frac{2}{5}E$ $p = \frac{2E}{5V} = 1.35 \times 10^5 pa$

(2) $\bar{\varepsilon}_{kt} = \frac{3}{2}kT = \frac{3}{2}\frac{p}{n} = \frac{3}{2}\frac{pV}{N} = 7.49 \times 10^{-21} J$

$T = \frac{2\bar{\varepsilon}_{kt}}{3k} = 3.62 \times 10^2 K$

12-19 (1) $\bar{\varepsilon}_{kt} = \frac{3}{2}kT$ 得 $T = 300K$

a: $\bar{\varepsilon}_{kt} = \frac{3}{2}kT = \bar{\varepsilon}_k = 6.21 \times 10^{-21} J$

(2) $v = \sqrt{\frac{2RT}{M}} = 3.95 \times 10^2 m/s$

12-24 (1) 面积为在 0-v 区间内分子的数量.

(2) $N = \frac{3v_0 \times a}{2}$ $\therefore a = \frac{2N}{3v_0}$

(3) $(\frac{a}{2} + a) \times \frac{v_0}{2} \times \frac{1}{2} + a \times \frac{1}{2}v_0 = \frac{3av_0}{8} + \frac{1}{2}av_0 = \frac{7}{8}av_0 = \frac{7}{8} \times \frac{2N}{3} = \frac{7N}{12}$

∴分子数为 $\frac{7}{12}N$。

(4) $0 \sim v_0$ $Nf(v) = \frac{2N}{3v_0^2}v$ $v_0 \sim 2v_0$ $a = \frac{2N}{3v_0} = Nf(v)$

$\therefore \bar{\varepsilon}_{kt} = \frac{\int_0^{v_0} \frac{1}{2}mv^2 \cdot Nf(v)\,dv + \int_{v_0}^{2v_0} \frac{1}{2}mv^2 \times Nf(v)\,dv}{N}$

$= \frac{\int_0^{v_0} \frac{1}{2}mv^2 \cdot \frac{2N}{2v_0^2}v\,dv + \int_{v_0}^{2v_0} \frac{1}{2}mv^2 \times \frac{2N}{3v_0}\,dv}{N}$

$= (\frac{1}{12} + \frac{7}{9})mv_0^2 = \frac{31}{36}mv_0^2$

12-27 $p = p_0 e^{-\frac{mgh}{kT}}$ 得 $h = \frac{kT}{mg}\ln\frac{p_0}{p} = \frac{RT}{Mg}\ln\frac{p_0}{p} = 1.93 \times 10^3 m$.

12-29 由 $p = nkT$ 得 ~~$p_0 = \frac{T_0}{T_1}p$~~ ~~$\frac{p_1}{p_2} = \frac{n_1}{n_2}$~~

$n = \frac{p}{kT}$ $p = 1.33 \times 10^{-11} pa$ 时 $n = 3.21 \times 10^9 m^{-3}$

$\bar{\lambda} = \frac{1}{\sqrt{2}\pi d^2 n} = \frac{kT}{\sqrt{2}\pi d^2 p} = 7.8 \times 10^8 m$.

$p = 1.33 \times 10^{-3} pa$ 时 $n = \frac{p}{kT} = 3.21 \times 10^{17} m^{-3}$

$\bar{\lambda} = \frac{kT}{\sqrt{2}\pi d^2 p} = 7.8 mm$

12-30 $\bar{z} = \sqrt{2}\pi d^2 n \bar{v} = \sqrt{2}\pi d^2 \bar{v} \frac{p}{kT} = \sqrt{2}\pi d^2 \frac{p}{kT} \times 1.6 \sqrt{\frac{RT}{M}}$

$= 3.81 \times 10^6 \ s^{-1}$

12-31 (1) $\bar{\lambda} = \frac{kT}{\sqrt{2}\pi d^2 p}$ $\therefore \frac{\bar{\lambda}_1}{\bar{\lambda}_2} = \frac{d_2^2}{d_1^2} = \frac{2759.9 \times 10^{-8}}{9 \cdot 27.5 \times 10^{-8}}$。

$\therefore$ 即 $\frac{d_1}{d_2} = \sqrt{\frac{\bar{\lambda}_2}{\bar{\lambda}_1}} = 1.67$

(2) $\bar{\lambda} = \frac{kT}{\sqrt{2}\pi d^2 p}$ p为原来的$\frac{1}{2}$ 自由程为原来的两倍

$\bar{\lambda}_1 = 5.5 \times 10^{-7} \ m$

$\bar{z} = \frac{\bar{v}_{N_2}}{\bar{\lambda}_{N_2}} = \frac{\sqrt{\frac{8RT}{\pi M}}}{2\bar{\lambda}} = 8.56 \times 10^8 \ s^{-1}$