§5. 296

(1) $f(v) = -a(v-50)^2 + k$, $v = 50\ m/s$

(2) $\int_{49}^{51} aV(100-V)\,dV = a(50V^2 - \frac{1}{3}V^3)\Big|_{49}^{51}$

$\int_0^{100} aV(100-v)\,dV = 1$ ~~$= 2.5 \times 10^{-10}$~~ $\Rightarrow a = 6 \times 10^{-6}$

$\therefore$ 概率 $= 3.60 \times 10^{-8}$ 个

(3) $\bar{v} = \int_0^{50} V\,aV(100-V)\,dV \Big/ \int_0^{50} aV(100-V)\,dV = 31.25\ m/s$

296. 8-6

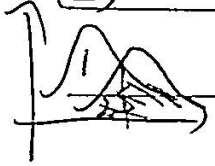
(1) ~~V_p~~ $f(v) = 4\pi\left(\frac{m}{2\pi k_B T}\right)^{\frac{3}{2}} e^{-\frac{m}{2k_B T}V^2} V^2$

$f'(V_p) = 0 \Rightarrow$ ~~$f(V_p) =$~~ $2V_p e^{\frac{m}{2k_B T}V^2} - \frac{mV_p^3}{k_B T} e^{-\frac{m}{2k_B T}V^2} = 0$

$\Rightarrow V_p = \sqrt{\frac{2k_B T_1}{m}}$, $f_1(V_1) = f_2(V_1) \Rightarrow k_B = \frac{mV_1^2}{3(\ln T_2 - \ln T_1)}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

$\therefore V_p = V_1\sqrt{\frac{2(T_2 - T_1)}{3T_2 \ln \frac{T_2}{T_1}}}$

(2)



$0 = 1$ 甲, $1+S = 1$ 乙 $\Rightarrow 0 = 1 - S$

296. 8-7

$f(v) = \begin{cases} Av^2 & 0 < v \le v_m \\ 0 & v > v_m \end{cases}$ $\quad \bar{v} = \frac{N\int_0^{v_m} Av^3\,dv}{N} = \frac{A}{4}v_m^4 = \frac{3}{4}v_m$.

$\int_0^{v_m} Av^2\,dv = 1 \Rightarrow A = \frac{3}{v_m^3}$

296. 8-8

(1) $\frac{1}{2} \times (30+60) \times a + 30 \times a = 1 \Rightarrow a = \frac{1}{75}$

$\therefore N_0 \times \frac{1}{2} \times 30 \times a = 1.44 \times 10^{10}$ 个

(2) 约 $\therefore N' = N_0 \times f(100) \times \Delta v = 6.4 \times 10^8$

(3) $\bar{v} = \sum v_i f(v_i) = 54\ m/s$

(4) $\bar{v}' = \frac{\int_{60}^{100} v f(v)\,dv}{\int_{60}^{100} f(v)\,dv} = 80\ m/s$