38. (a) Rather than use $P(v)$ as it is written in Eq. 20-27, we use the more convenient nK expression given in problem 37 of this chapter [44]. The $n(K)$ expression can be derived from Eq. 20-27, but we do not show that derivation here. To find the most probable energy, we take the derivative of $n(K)$ and set the result equal to zero:

$$\left.\frac{dn(K)}{dK}\right|_{K=K_p} = \left.\frac{1.13n}{(kT)^{3/2}}\left(\frac{1}{2K^{1/2}} - \frac{K^{3/2}}{kT}\right)e^{-K/kT}\right|_{K=K_p} = 0\,,$$

which gives $K_p = \frac{1}{2}kT$. Specifically, for $T = 1.5 \times 10^7\,\text{K}$ we find

$$K_p = \frac{1}{2}kT = \frac{1}{2}(8.62 \times 10^{-5}\,\text{eV/K})(1.5 \times 10^7\,\text{K}) = 6.5 \times 10^2\ \text{eV}$$

or $0.65\,\text{keV}$, in good agreement with Fig. 44-10.

(b) Eq. 20-35 gives the most probable speed in terms of the molar mass M, and indicates its derivation (see also Sample Problem 20-6). Since the mass m of the particle is related to M by the Avogadro constant, then

$$v_p = \sqrt{\frac{2RT}{M}} = \sqrt{\frac{2RT}{m\,N_A}} = \sqrt{\frac{2kT}{m}}$$

using Eq. 20-7. With $T = 1.5 \times 10^7\,\text{K}$ and $m = 1.67 \times 10^{-27}\,\text{kg}$, this yields $v_p = 5.0 \times 10^5\ \text{m/s}$.

(c) The corresponding kinetic energy is

$$K_{v,p} = \frac{1}{2}mv_p^2 = \frac{1}{2}m\left(\sqrt{\frac{2kT}{m}}\right)^2 = kT$$

which is twice as large as that found in part (a). Thus, at $T = 1.5 \times 10^7\,\text{K}$ we have $K_{v,p} = 1.3\,\text{keV}$, which is indicated in Fig. 44-10 by a single vertical line.