20. The molar mass of carbon is $m = 12.01115\,\mathrm{g/mol}$ and the mass of the Earth is $M_e = 5.98 \times 10^{24}\,\mathrm{kg}$. Thus, the number of carbon atoms in a diamond as massive as the Earth is $N = (M_e/m)N_\mathrm{A}$, where N_A is the Avogadro constant. From the result of Sample Problem 42-1, the probability in question is given by

$$\begin{aligned} P &= Ne^{-E_g/kT} = \left(\frac{M_e}{m}\right) N_\mathrm{A} e^{-E_g/kT} \\ &= \left(\frac{5.98 \times 10^{24}\,\mathrm{kg}}{12.01115\,\mathrm{g/mol}}\right)(6.02 \times 10^{23}/\mathrm{mol})(3 \times 10^{-93}) = 9 \times 10^{-43}\ . \end{aligned}$$