TABLE I. *The functions $h_i(\nu)$.*

ν	$h_1(\nu)$	$h_2(\nu)$	ν	$h_1(\nu)$	$h_2(\nu)$
4	0.38824	0.86761	8	0.27799	0.64567
5	0.33736	0.76777	9	0.26804	0.62385
6	0.30934	0.71143	10	0.26016	0.60609
7	0.29107	0.67360	11	0.25372	0.59123

sphere model and, to the first degree in E/kT, for the Sutherland model; other models required numerical integration. The results have been summarized in reference 1 and by Jones.[2]

Assume that $V(r)$ has a single minimum $-E=V(r_0)<0$, is negative for $r>r_0$, approaches zero more rapidly than r^{-2} for large r, and becomes positively infinite for small r. The ϕ integral will be broken up into the ranges $b\leqq b_0$, and $b\geqq b_0$, where $b_0=r_0(1+R)^{\frac{1}{2}}$, $R=E/kTy^2$, corresponding to $r_{00}\leqq r_0$ and $r_{00}\geqq r_0$, respectively. In the first range put $r=b/v$ and add and subtract R in the denominator.

$$\chi=\pi-2\int_0^{v_{00}}[1+R-v^2-R\{1+V(v)/E\}]^{-\frac{1}{2}}dv.$$

Since $V(v)\geqq -E$ and $[\ ]\geqq 0$, it follows that $\{1+R-v^2\}\geqq R\{1+V(v)/E\}$ and the radical may be expanded. In the second range add and subtract $S=-V(r_{00})/kTy^2$ and expand the radical. This procedure gives χ in powers of $R/(1+R)$ or $S/(1+S)$, and $\cos\chi$ may then be put in similar series form. After integrating over the proper range of b, and over y, the final result is:

$$\Omega(i,s)=(2\pi m_0kT/m_1m_2)^{\frac{1}{2}}[W_0(i,s)-W_1(i,s)+U_2(i,s)-W_2(i,s)+\tfrac{3}{2}U_3(i,s)-W_3(i,s)+\cdots];$$

where

$$W_n(i,s)=\int_0^\infty \exp(-y^2)y^{2s+3}H_n(i,R)dy,$$

$$H_n(i,R)=R^n/(1+R)^n\int_0^1 G_n(i,z)\{d(b^2)/d(z^2)\}zdz,$$

$$G_0(1,z)=2(1-z^2),\quad G_0(2,z)=4z^2(1-z^2),$$

$$G_1(1,z)=2z(1-z^2)^{\frac{1}{2}}F_1(z),\quad G_1(2,z)=2(2z^2-1)G_1(1,z),$$

$$G_2(1,z)=\tfrac{3}{2}z(1-z^2)^{\frac{1}{2}}F_2(z)-\tfrac{1}{2}(2z^2-1)F_1^2(z),$$

$$G_2(2,z)=2(2z^2-1)G_2(1,z)+G_1^2(1,z),$$

$$G_3(1,z)=z(1-z^2)^{\frac{1}{2}}[\tfrac{5}{4}F_3(z)-\tfrac{1}{3}F_1^3(z)]-\tfrac{3}{4}(2z^2-1)F_1(z)F_2(z),$$

$$G_3(2,z)=2(2z^2-1)G_3(1,z)+2G_1(1,z)G_2(1,z),$$

$$F_n(z)=\int_0^z[1+V_1(x)/E]^n(1-x^2)^{-n-\frac{1}{2}}dx,$$

$$V_1(x)=V(r)\quad\text{with}\quad 1/r=x(1+R)^{\frac{1}{2}}/b,$$

$$U_n(i,s)=\tfrac{1}{2}i\int_0^\infty \exp(-y^2)y^{2s+3}I_n(y)dy,$$

$$I_2(y)=\int_{b_0}^\infty[S/(1+S)]^2J_1^2(b)bdb,$$

$$I_3(y)=\int_{b_0}^\infty[S/(1+S)]^3J_1(b)J_2(b)bdb,$$

$$J_n(b)=\int_0^1[1-V_2(x)/V_2(x_{00})]^n(1-x^2)^{-n-\frac{1}{2}}dx,$$

$$V_2(x)=V(r)\quad\text{with}\quad 1/r=x(1+S)^{\frac{1}{2}}/b.$$

The functions W_n and U_n will be in general of order not greater than $(E/kT)^n$, so that for high temperatures only the first few terms are of importance. Although Ω is not given in closed form, the choice of integrable functions $V(r)$ is considerably greater.

Applied to the Sutherland model, with molecular diameter σ, and attractive force varying as $1/r^2$, this method gives:

$$\Omega(i,s)=(\pi m_0kT/2m_1m_2)^{\frac{1}{2}}\sigma^2[(s+1)!f_i+s!g_i(\nu)E/kT+(s-1)!h_i(\nu)(E/kT)^2+\cdots].$$

$f_1=\frac{1}{2}$ and $f_2=\frac{1}{3}$. The functions g_1 and g_2 have already been calculated by James[3] by another method, and are tabulated by Jones[2] with the notation i, and i_2. h_1 and h_2 have been evaluated in terms of the digamma function and are given in Table I. Further approximations to Ω require tabular values of the logarithmic integral. As predicted by James,[3] the functions h_2 are positive, whereas the viscosity data of the rare gases demand that these coefficients be negative. It is evident that the Sutherland model cannot yield accurate results for viscosity or thermal diffusion unless $(E/kT)^2$ is negligible.

Calculations are now in progress for a molecular model possessing both an attractive and a repulsive field.

[1] S. Chapman and T. G. Cowling, *The Mathematical Theory of Non-Uniform Gases* (Cambridge, 1939).
[2] R. C. Jones, Phys. Rev. **58**, 111 (1940).
[3] C. G. F. James, Proc. Camb. Phil. Soc. **20**, 447 (1921).

Radioactive Argon A^{37}

PAUL K. WEIMER, J. D. KURBATOV, AND M. L. POOL
Department of Physics, The Ohio State University, Columbus, Ohio
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AN artificially radioactive gas has been produced by bombarding solid samples containing potassium, chlorine, calcium, or sulfur with appropriate nuclear particles. The radioactivity has been observed for three months and is found to have a single decay period of 34 days.

Two radioactive isotopes of argon are already known. They are A^{41} which has a half-life of 110 minutes,[1] and A^{35} which has a half-life of two seconds.[2]

In view of the method by which the present activity has been produced, we assign it to A^{37}. To substantiate this assignment the following reactions have been carried out and in each case found to yield a radioactive gas of 34-day half-life.

$$\begin{aligned}
Cl^{37}+H^2 &\rightarrow A^{37}+2n\\
Cl^{37}+H^1 &\rightarrow A^{37}+n\\
K^{39}+H^2 &\rightarrow A^{37}+He^4\\
Ca^{40}+n &\rightarrow A^{37}+He^4\\
S^{34}+He^4 &\rightarrow A^{37}+n
\end{aligned}$$

After chemical treatment of the bombarded sample, the gas liberated was passed through a sodium hydroxide solution and calcium chloride drying tubes, and then admitted into an ionization chamber which was connected to a Wulf bifilar electrometer. Experiments on the type of radiation emitted are in progress.

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[1] Arthur H. Snell, Phys. Rev. **49**, 555 (1936).
[2] L. D. P. King and D. R. Elliott, Phys. Rev. **59**, 108A (1941), M. G. White, E. C. Creutz, L. A. Delsasso, and R. R. Wilson, Phys. Rev. **59**, 63 (1941).