

53. The radial probability function for the ground state of hydrogen is $P(r) = (4r^2/a^3)e^{-2r/a}$, where a is the Bohr radius. (See Eq. 40-31.) We want to evaluate the integral $\int_0^\infty P(r) dr$. Eq. 15 in the integral table of Appendix E is an integral of this form. We set $n = 2$ and replace a in the given formula with $2/a$ and x with r . Then

$$\int_0^\infty P(r) dr = \frac{4}{a^3} \int_0^\infty r^2 e^{-2r/a} dr = \frac{4}{a^3} \frac{2}{(2/a)^3} = 1 .$$