

57. 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.) The integral table of Appendix E may be used to evaluate the integral  $r_{\text{avg}} = \int_0^\infty rP(r) dr$ . Setting  $n = 3$  and replacing  $a$  in the given formula with  $2/a$  (and  $x$  with  $r$ ), we obtain

$$r_{\text{avg}} = \int_0^\infty rP(r) dr = \frac{4}{a^3} \int_0^\infty r^3 e^{-2r/a} dr = \frac{4}{a^3} \frac{6}{(2/a)^4} = 1.5a .$$