55. Since Δr is small, we may calculate the probability using $p = P(r)\,\Delta r$, where $P(r)$ is the radial probability density. The radial probability density for the ground state of hydrogen is given by Eq. 40-31:

$$P(r) = \left(\frac{4r^2}{a^3}\right) e^{-2r/a}$$

where a is the Bohr radius.

(a) Here, $r = 0.500a$ and $\Delta r = 0.010a$. Then,

$$p = \left(\frac{4r^2\,\Delta r}{a^3}\right) e^{-2r/a} = 4(0.500)^2(0.010)\,e^{-1} = 3.68 \times 10^{-3}\ .$$

(b) We set $r = 1.00a$ and $\Delta r = 0.010a$. Then,

$$p = \left(\frac{4r^2\,\Delta r}{a^3}\right) e^{-2r/a} = 4(1.00)^2(0.010)\,e^{-2} = 5.41 \times 10^{-3}\ .$$