5. **REASONING AND SOLUTION** The surface area of a sphere is \( \text{Area} = 4\pi r^2 \). But according to Equation 31.2, the radius of a nucleus in meters is \( r = (1.2 \times 10^{-15} \text{ m}) A^{1/3} \), where \( A \) is the nucleon number. With this expression for \( r \), the surface area becomes \( \text{Area} = 4\pi (1.2 \times 10^{-15} \text{ m})^2 A^{2/3} \). The ratio of the largest to the smallest surface area is, then,

\[
\frac{\text{Largest area}}{\text{Smallest area}} = \frac{4\pi (1.2 \times 10^{-15} \text{ m})^2 A_{\text{largest}}^{2/3}}{4\pi (1.2 \times 10^{-15} \text{ m})^2 A_{\text{smallest}}^{2/3}} = 209^{2/3} 1^{2/3} = 35.2
\]

9. **REASONING** According to Equation 31.2, the radius of a nucleus in meters is \( r = (1.2 \times 10^{-15} \text{ m}) A^{1/3} \), where \( A \) is the nucleon number. If we treat the neutron star as a uniform sphere, its density (Equation 11.1) can be written as

\[
\rho = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi r^3}
\]

Solving for the radius \( r \), we obtain,

\[
r = \left( \frac{M}{\frac{4}{3}\pi \rho} \right)^{1/3}
\]

This expression can be used to find the radius of a neutron star of mass \( M \) and density \( \rho \).

**SOLUTION** As discussed in Conceptual Example 1, nuclear densities have the same approximate value in all atoms. If we consider a uniform spherical nucleus, then the density of nuclear matter is approximately given by

\[
\rho = \frac{M}{V} \approx \frac{A \times (\text{mass of a nucleon})}{\frac{4}{3}\pi r^3} = \frac{A \times (\text{mass of a nucleon})}{\frac{4}{3}\pi \left(1.2 \times 10^{-15} \text{ m}\right)^3 A^{1/3}}
\]

\[
= \frac{1.67 \times 10^{-27} \text{ kg}}{\frac{4}{3} \pi (1.2 \times 10^{-15} \text{ m})^3} = 2.3 \times 10^{17} \text{ kg/m}^3
\]
Substituting values into the expression for \( r \) determined above, we have

\[
r = \sqrt[3]{\frac{4}{3} \pi \left( \frac{0.40}{1.99 \times 10^{30} \text{ kg}} \right)^4 \left( \frac{2.3 \times 10^{17} \text{ kg/m}^3}{\pi} \right)} = 9.4 \times 10^{3} \text{ m}
\]

25. **REASONING AND SOLUTION** The general form for \( \beta^+ \) decay is

\[
\frac{A}{Z} P \rightarrow \frac{A}{Z-1} D + ^{0}_{+1}e \quad \text{(positron)}
\]

a. Therefore, the \( \beta^+ \) decay process for \( _{9}^{18}F \) is \( _{9}^{18}F \rightarrow _{8}^{18}O + ^{0}_{+1}e \).

b. Similarly, the \( \beta^+ \) decay process for \( _{8}^{15}O \) is \( _{8}^{15}O \rightarrow _{7}^{15}N + ^{0}_{+1}e \).

57. **REASONING AND SOLUTION** As shown in Figure 31.17, if the first dynode produces 3 electrons, the second produces 9 electrons \( (3^2) \), the third produces 27 electrons \( (3^3) \), so the \( N^{th} \) produces \( 3^{N} \) electrons. The number of electrons that leaves the 14th dynode and strikes the 15th dynode is

\[
3^{14} = 4782969 \text{ electrons}
\]