Nuclear Physics

Answer Key

1. **Answer**: C

Explanation: Using the formula $R = R_0 A^{\frac{1}{3}}$, we can solve the approximate nuclear radius of the given nuclide. Given that $R_0 = 1.2 \times 10^{-15}$ m and A = 19:

$$R = R_0 A^{\frac{1}{3}}$$

$$R = (1.2 \, x \, 10^{-15} \, m)(19)^{\frac{1}{3}} = 3.20 \, x \, 10^{-15} \, m$$

2. **Answer:** D

Explanation: Following the rules in determining stability, we can immediately say that ${}^{242}_{93}Cm$ is unstable by virtue of Rule 3 (isotopes with atomic numbers greater than 83 are radioactive). But to expound on this, we are sure that ${}^{4}_{2}He$ and ${}^{40}_{20}Ca$ are stable because they have double magic numbers (2 protons and 2 neutrons for ${}^{4}_{2}He$ and 20 protons and 20 neutrons for ${}^{40}_{20}Ca$), while ${}^{209}_{83}Bi$, although in the boundary of Rule 3, can be concluded as more stable than ${}^{242}_{93}Cm$ since ${}^{209}_{83}Bi$ have 83 protons and 126 neutrons, and 126 is a magic number! Therefore, the most unstable nuclide is ${}^{242}_{93}Cm$.

3. **Answer:** A

Explanation: To answer this question, what we can do is compute the n/p ratio. From the given notation, we know that U-239 has 147 neutrons and 92 protons. Since the numerator is larger than the denominator, that means n/p > 1. This means that we are given a radioactive nuclide positioned above the belt of stability, which, to become more stable, undergoes -decay!

4. **Answer:** A

Explanation: The question is the definition of mass defect. These differences arise from the fact that some of the mass is converted to energy and released to the environment whenever a nuclide is formed from its constituent protons, neutrons, and electrons.

5. **Answer:** D

Explanation: The number of neutrons can be calculated by subtracting 43 from 92, making option A correct. Also, since ${}^{92}_{43}Tc$ is electrically neutral, this implies that the number of protons = number of neutrons. Since there are 43 protons, the number of electrons is also 43. Option C is also correct by virtue of Rule 3, which states that "all isotopes of Tc (Z = 43) are radioactive!"