Nuclear Chemistry

Answer Key

1. **Answer**: B

Explanation: We can see that both nuclides have different mass numbers and atomic numbers. However, we can determine that both nuclides have 16 neutrons. By definition, atoms with the same number of neutrons but different numbers of protons are called isotones.

2. **Answer:** A

Explanation: Remember that there are only two rules in balancing nuclear reactions, and these are the total of the subscripts and superscripts on the left side of the reaction must be equal to the total of the subscripts and superscripts on the right side. On the left side, the total of the superscripts is 29. To balance this, A must be 28. For the subscripts, the total on the left side is 14; therefore Z must be 13. With this, options C and D are already eliminated as the correct answer. Between options A and B, recall that the atomic number (Z) is unique for every element and can be seen in the periodic table as the number listed on top of the chemical symbol. With this, Al is the only element with an atomic number of 13, hence the correct answer is option A. Most examinations provide a copy of the periodic table of elements, but to be sure, it is advisable to memorize some of the common elements, their chemical symbols, atomic mass, and atomic number.

3. **Answer:** B

Explanation: By balancing the given reaction, we can determine that the correct identity of ${}_{Z}^{A}X$ is actually ${}_{2}^{4}He$. Since an alpha particle was emitted, the reaction is an alpha decay or alpha particle emission reaction.

4. **Answer:** A

Explanation: If no values were given, you can always assign arbitrary values to visualize the problem. For this problem, let's say we have 1.0 g of ^{131}I as the initial amount. After 8 days (1st half-life), the amount will be reduced to half the original amount, which is 0.5 g. After another 8 days (2nd half-life), the amount will be further reduced to half, from 0.5 g to 0.25 g. At this point,

the existing amount is only a quarter of 1.0 g; hence, the correct answer is 2 half-lives. Always make sure that you understand the question before selecting an answer. Although it will take 16 days based on our analysis, it is not what is being asked. Therefore, you will not get the answer correctly if you selected option C, which is 16.

5. **Answer:** B

Explanation: Recall that all nuclear reactions follow a first-order rate law, and half-life can be computed using the formula $t_{½} = \frac{ln\,2}{k}$. However, in this problem, we are asked to provide an expression that will give the value of k given $t_{½}$. Rearranging the equation will give us:

$$k = \frac{ln\,2}{t_{0.5}}$$

Since $t_{½}$ = 1.1 s, we can substitute this value to the equation above, giving the expression in option B.