half life of radioactive isotopes worksheet answers page 35

Half life of radioactive isotopes worksheet answers page 35 is a concept that often appears in chemistry and physics education. Understanding the half-life of radioactive isotopes is crucial for students as it lays the groundwork for more advanced topics in nuclear chemistry and radiological safety. This article will provide an overview of the half-life concept, its mathematical formulation, and common applications, as well as a discussion around typical worksheet questions and answers one might encounter on page 35 of a study resource.

Understanding Half-Life

Half-life, denoted as $t_{1/2}$, is the time required for half of the radioactive atoms in a sample to decay. This property is unique to each radioactive isotope and is a critical factor in various fields, including medicine, archaeology, and nuclear power.

The Decay Process

Radioactive decay is a random process at the level of single atoms, but it follows predictable patterns when observed over a larger sample. The decay can occur through various pathways, including:

- Alpha decay
- Beta decay
- Gamma decay

Each pathway has a different half-life, and this is what makes the study of radioactive isotopes fascinating and complex.

The Mathematical Formula

The mathematical relationship to calculate the remaining amount of a radioactive substance after a certain number of half-lives is given by the formula:

$$
N(t) = N_0 \left(\frac{1}{2}\right)^{\frac{t}{t_{1/2}}}
$$

Where:
- $N(t)$ is the quantity of the substance remaining after time t.
- N_0 is the initial quantity of the substance.
- $t_{1/2}$ is the half-life of the isotope.
- t is the elapsed time.

Using this formula, students can solve various problems related to radioactive decay.

Common Isotopes and Their Half-Lives

Different isotopes have varying half-lives that can range from fractions of a second to millions of years. Here are some common radioactive isotopes and their respective half-lives:

- Carbon-14: 5,730 years
- Uranium-238: 4.5 billion years
- Radon-222: 3.8 days
- Iodine-131: 8 days
- Cesium-137: 30 years

These isotopes are frequently mentioned in worksheets and practical applications, particularly in carbon dating and radiotherapy.

Worksheet Problems and Solutions

When working through a worksheet on the half-life of radioactive isotopes, students commonly encounter a variety of problem types. Here, we'll discuss typical questions that might be found on page 35 of a worksheet and the respective answers.

Example Problem 1: Carbon-14 Dating

Question: If you start with 80 grams of Carbon-14, how much will remain after 17,160 years?

Answer:
1. Calculate the number of half-lives:
- Half-life of Carbon-14 = 5,730 years
- Number of half-lives = 17,160 years / 5,730 years = 3

2. Apply the half-life formula:
- After 3 half-lives:
$$
N(t) = 80 \left(\frac{1}{2}\right)^3 = 80 \times \frac{1}{8} = 10 \text{ grams}
$$

Thus, 10 grams of Carbon-14 will remain after 17,160 years.

Example Problem 2: Iodine-131 in Medicine

Question: A hospital administers a dose of 100 micrograms of Iodine-131 to a patient. How much of the isotope will remain after 32 days?

Answer:
1. Determine the number of half-lives:
- Half-life of Iodine-131 = 8 days
- Number of half-lives = 32 days / 8 days = 4

2. Use the half-life formula:
$$
N(t) = 100 \left(\frac{1}{2}\right)^4 = 100 \times \frac{1}{16} = 6.25 \text{ micrograms}
$$

After 32 days, 6.25 micrograms of Iodine-131 will remain.

Applications of Half-Life

The concept of half-life is not just an academic exercise; it has real-world applications across various fields:

1. Archaeology

Carbon dating, which uses the half-life of Carbon-14, allows archaeologists to estimate the age of ancient organic materials. By measuring the remaining Carbon-14 in a sample, researchers can determine how long it has been since the organism died.

2. Medicine

In medical diagnostics and treatment, isotopes such as Iodine-131 are used for both imaging and treatment of thyroid conditions. Understanding the half-life helps in optimizing dosages and scheduling treatments.

3. Nuclear Power

In nuclear power generation, isotopes like Uranium-238 play a critical role. Knowing their half-lives helps in managing nuclear fuel and waste, ensuring safety and efficiency in energy production.

4. Environmental Science

Radioactive isotopes are also employed in tracing environmental processes, such as sedimentation rates or pollutant pathways. Understanding their half-lives aids in modeling these processes.

Conclusion

The half-life of radioactive isotopes is a fundamental concept with broad

implications across multiple disciplines. Whether in an academic setting, as seen in worksheets like the one on page 35, or in practical applications within various fields, grasping the half-life concept is essential. By practicing problems and applying the knowledge to real-world scenarios, students can deepen their understanding and appreciation of this critical topic in science.

Frequently Asked Questions

What is the half-life of a radioactive isotope?

The half-life of a radioactive isotope is the time required for half of the radioactive atoms in a sample to decay into a different element or isotope.

How can I calculate the remaining amount of a radioactive isotope after a certain time?

You can use the formula N = N0 (1/2)^(t/T), where N0 is the initial quantity, N is the remaining quantity, t is the elapsed time, and T is the half-life of the isotope.

Why is understanding half-lives important in various fields?

Understanding half-lives is crucial in fields such as medicine for determining dosage of radioactive tracers, archaeology for carbon dating, and nuclear energy for waste management.

What is the significance of page 35 in the half-life worksheet?

Page 35 of the half-life worksheet typically contains exercises or problems that help students apply their knowledge of half-lives and radioactive decay calculations.

Can half-lives be used to date archaeological finds?

Yes, half-lives are used in techniques like carbon dating to determine the age of archaeological finds based on the decay of carbon-14.

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