

Half Life Calculations Worksheet With Answers

HALF-LIFE OF RADIOACTIVE ISOTOPES		Name _____
1. How much of a 100.0 g sample of ^{198}Au is left after 8.10 days if its half-life is 2.70 days?	$\frac{8.1}{2.7} = 3$ $\frac{100}{2} = 50$ $\frac{50}{2} = 25$ $\frac{25}{2} = 12.5$	<u>12.5 g</u>
2. A 50.0 g sample of ^{16}N decays to 12.5 g in 14.4 seconds. What is its half-life?	$ \begin{array}{ccccc} 50\text{ g} & & 25\text{ g} & & 12.5\text{ g} \\ & \xrightarrow{7.7\text{ sec}} & & \xrightarrow{7.7\text{ sec}} & \\ & 14.4\text{ sec} & & & \end{array} $	<u>7.7 sec</u>
3. The half-life of ^{40}K is 12.4 hours. How much of a 750 g sample is left after 62.0 hours?	$\frac{62}{12.4} = 5$ $\left(\frac{750}{2}\right) = 375$ $\left(\frac{375}{2}\right) = 187.5$ $\frac{187.5}{2} = 93.75$ $\frac{93.75}{2} = 46.875$	<u>23.4 g</u>
4. What is the half-life of ^{99}Tc if a 500 g sample decays to 62.5 g in 639,000 years?	$\frac{500}{62.5} = 8$ $\frac{639,000}{8} = 79,875$	<u>79,875 yr</u>
5. The half-life of ^{232}Th is 1.4×10^{10} years. If there are 25.0 g of the sample left after 2.8×10^{10} years, how many grams were in the original sample?	$\frac{2.8 \times 10^{10}}{1.4 \times 10^{10}} = 2$ $2^2 = 4$ $25.0 \cdot 4 = 100.0$	<u>100.0 g</u>
6. There are 5.0 g of ^{131}I left after 40.35 days. How many grams were in the original sample if its half-life is 8.07 days?	$\frac{40.35}{8.07} = 5$ $2^5 = 32$ $32 \cdot 5 = 160$	<u>160 g</u>

Half life calculations worksheet with answers are essential tools for students and professionals alike. They provide a systematic approach to understanding the concept of half-life, which is critical in fields such as chemistry, physics, and radiology. This article will delve into the importance of half-life calculations, provide step-by-step methods to solve problems, and offer a comprehensive worksheet with answers for practice.

Understanding Half-Life

Half-life is defined as the time required for a quantity to reduce to half its initial value. This concept is widely used in various scientific disciplines, especially when dealing with radioactive decay, pharmacokinetics, and other processes that exhibit exponential decay.

The Importance of Half-Life Calculations

Half-life calculations are crucial for:

- **Radioactive Decay:** Understanding how long it takes for half of a radioactive substance to decay is vital in nuclear medicine and environmental science.
- **Pharmacology:** Half-life helps in determining dosing schedules for medications to maintain therapeutic levels in the bloodstream.
- **Environmental Science:** Assessing how long contaminants remain in the environment can influence cleanup strategies.

Basic Formula for Half-Life Calculations

The general formula to calculate the remaining quantity of a substance after a certain number of half-lives is:

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

Where:

- $N(t)$ = remaining quantity after time t
- N_0 = initial quantity
- t = total time elapsed
- $t_{1/2}$ = half-life

Examples of Half-Life Calculations

Let's go through a couple of examples to illustrate how to apply this formula effectively.

Example 1: Radioactive Decay

Suppose you start with a 100g sample of a radioactive substance that has a half-life of 5 years. To find out how much of the substance remains after 15 years:

1. Calculate the number of half-lives:

$$\left[\text{Number of half-lives} = \frac{15 \text{ years}}{5 \text{ years/half-life}} = 3 \right]$$

2. Apply the half-life formula:

$$\left[N(t) = 100g \left(\frac{1}{2} \right)^3 = 100g \times \frac{1}{8} = 12.5g \right]$$

Thus, after 15 years, 12.5g of the radioactive substance remains.

Example 2: Pharmacokinetics

Consider a medication that has a half-life of 4 hours. If a patient takes a dose of 200 mg, how much of the drug remains in their system after 12 hours?

1. Calculate the number of half-lives:

$$\left[\text{Number of half-lives} = \frac{12 \text{ hours}}{4 \text{ hours/half-life}} = 3 \right]$$

2. Apply the half-life formula:

$$\left[N(t) = 200mg \left(\frac{1}{2} \right)^3 = 200mg \times \frac{1}{8} = 25mg \right]$$

So, after 12 hours, 25 mg of the medication remains in the patient's system.

Half-Life Calculations Worksheet

Now that we have established the fundamentals and examples of half-life calculations, let's create a worksheet for practice. Below are several problems to solve, followed by their answers.

Worksheet Problems

1. A certain isotope has a half-life of 10 years. If you start with 80g, how much will remain after 30 years?
2. A drug has a half-life of 6 hours. If the initial dose is 500 mg, how much will be left after 18 hours?
3. A radioactive element has a half-life of 2 days. If you initially have 160g, how much will remain after 8

days?

4. If a certain substance has a half-life of 1 hour, how much of a 1000 mg sample will remain after 3 hours?
5. A scientist starts with 50g of a material that has a half-life of 4 years. How much will remain after 16 years?

Answers to the Worksheet Problems

1. Answer: 10g

Explanation: After 30 years (3 half-lives), $\left(80g \left(\frac{1}{2}\right)^3 = 10g\right)$.

2. Answer: 62.5 mg

Explanation: After 18 hours (3 half-lives), $\left(500mg \left(\frac{1}{2}\right)^3 = 62.5mg\right)$.

3. Answer: 10g

Explanation: After 8 days (4 half-lives), $\left(160g \left(\frac{1}{2}\right)^4 = 10g\right)$.

4. Answer: 125 mg

Explanation: After 3 hours (3 half-lives), $\left(1000mg \left(\frac{1}{2}\right)^3 = 125mg\right)$.

5. Answer: 6.25g

Explanation: After 16 years (4 half-lives), $\left(50g \left(\frac{1}{2}\right)^4 = 6.25g\right)$.

Conclusion

Half life calculations worksheet with answers is a valuable resource for mastering this crucial concept. Understanding how to calculate half-lives not only enhances academic knowledge but also has practical applications in science and medicine. By practicing with worksheets and problems, students can solidify their grasp of the half-life concept and its applications in real-world scenarios.

Frequently Asked Questions

What is a half-life calculation worksheet used for?

A half-life calculation worksheet is used to help students and professionals understand and practice calculations related to the decay of radioactive substances over time.

How do you calculate the remaining quantity of a substance after a certain number of half-lives?

To calculate the remaining quantity, use the formula: $\text{Remaining Quantity} = \text{Initial Quantity} \times (1/2)^{(\text{number of half-lives})}$.

What information is typically included in a half-life calculations worksheet?

A half-life calculations worksheet usually includes initial quantity, half-life period, time elapsed, and problems requiring calculations of remaining quantity or number of half-lives.

Can half-life calculations be applied outside of chemistry?

Yes, half-life calculations can also be applied in fields such as pharmacology, environmental science, and any context involving exponential decay.

What are some common mistakes to avoid in half-life calculations?

Common mistakes include miscalculating the number of half-lives, confusing the half-life period with total time elapsed, and incorrect application of the decay formula.

Where can I find reliable half-life calculation worksheets with answers?

Reliable half-life calculation worksheets with answers can be found on educational websites, in chemistry textbooks, or through academic resources like online learning platforms.

What is the significance of understanding half-life in real-world applications?

Understanding half-life is crucial for applications such as determining safe disposal methods for radioactive waste, calculating medication dosages, and understanding the behavior of isotopes in various scientific fields.

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